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RESULTS OF THE NETTING OF BATS IN ALGERIA (MAMMALIA: CHIROPTERA)

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Abstract. Three hundred seventeen bats of 20 species were taken by nets at 26 localities, most of them in northern Algeria, in the years 1980—1983. This sample has been evaluted with regard to faunal size, relative abundance, species diversity in areas, and the foraging diversity of the species. The species diversity corresponds in a certain degree to the diversity of environment, and on the whole it is higher in samples from western Algeria than from the east of the country. The highest foraging diversity has been found in *P. kuhli*, the only species caught both in the Mediterranean zone and in the desert; a high foraging diversity is also shown by *M. blythi*, *P. pipistrellus*, *E. serotinus*, *R. ferrumequinum* and *P. austriacus*. The bats are less active in the Mediterranean zone as well as in oases in the Sahara in winter. Two peaks of nocturnal activity, with the maximum after sunset, have been ascertained in three most abundant species.

INTRODUCTION

The present paper is a sequel to our previous partial studies on bats collected in Algeria (Kowalski 1979, 1984, Gaisler 1983, 1984, Hanák and Gaisler 1984). We wish to contribute to the knowledge of communities of hunting bats in northwestern Africa by a comprehensive assessment of a sample obtained by mist netting. Besides the ecological aspect, there is new faunistic information, namely numerous data on the occurrence of bats.

METHODS AND MATERIAL

The netting of bats was done in the years 1980—1983, from April 1981 to August 1983 by the former author, and from June 1980 to September 1983 by the latter. In total, 126 nettings were performed, 67 of them positive, 59 not. Fine nylon mist nets manufactured in the USA, Federal Republic Germany and Japan were used, sized 2 x 5 m, 2 x 8 m and 2.5 x 10 m. Each netting began before sunset; about three quarters of them were discontinued before midnight, about one quarter after sunrise. The number of nets used for one netting varied from 1 to 6. More than three nets could be used at the same time only when the two authors were working together, which happened on twelve occasions (all positive). We captured altogether 317 bats of 20 species. The bats which were caught in the nets but escaped before or during bagging were not counted in the sample. The material is deposited in the collections of the Institute of Systematic and Experimental Zoology, PAS, Krakow, Poland, Department of Biology of Animals, Purkyně University, Brno, Czechoslovakia; and Regional Country Museum, Olomouc, Czechoslovakia.

RESULTS

Species, sampling localities and procedures

In total we obtained 2 ♀ *Rhinolophus mehelyi;* 2 ♂, 2 ♀ *R. blasii*; 4 ♂ *R. hipposideros;* 6 ♂, 3 ♀ *R. ferrumequinum;* 18 ♂, 5 ♀ *Asellia tridens;* 15 ♂, 12 ♀ *Myotis blythi;* 3 ♂, 2 ♀ *M. capaccinii*; 1 ♀ *M. emarginatus;* 1 ♀ *M. nattereri;* 18 ♂, 15 ♀ *Pipistrellus pipistrellus;* 32 ♂, 30 ♀ *P. kuhli;* 1 ♂, 2 ♀ *P. deserti;* 12 ♂, 8 ♀ *P. savii;* 2 ♂, 1 ♀ *P. rueppelli*; 4 ♂, 2 ♀ *Nyctalus leisleri;* 46 ♂, 23 ♀ *Eptesicus serotinus,* 2 ♂, 6 ♀ *Otonycteris hemprichi;* 12 ♂, 11 ♀ *Plecotus austriacus;* 2 ♂, 5 ♀ *Miniopterus schreibersi;* and 7 ♂ *Tadarida teniotis.* There are 186 males and 131 females in the whole sample, this difference being statistically significant at the 0.01 level.

The netting was successful at 26 localities, the situation of which is shown in Fig. 1. The localities were divided into ten areas, A — J as given below, by their geographic situation and the character of biotopes. Samples from the individual areas were assessed by the predominant species, faunal size (the number of species), and relative abundance. Relative abundance was computed after Kunz (1973) by dividing the number of individuals of each species by the number of net-nights in the area times 100. The number of net-nights

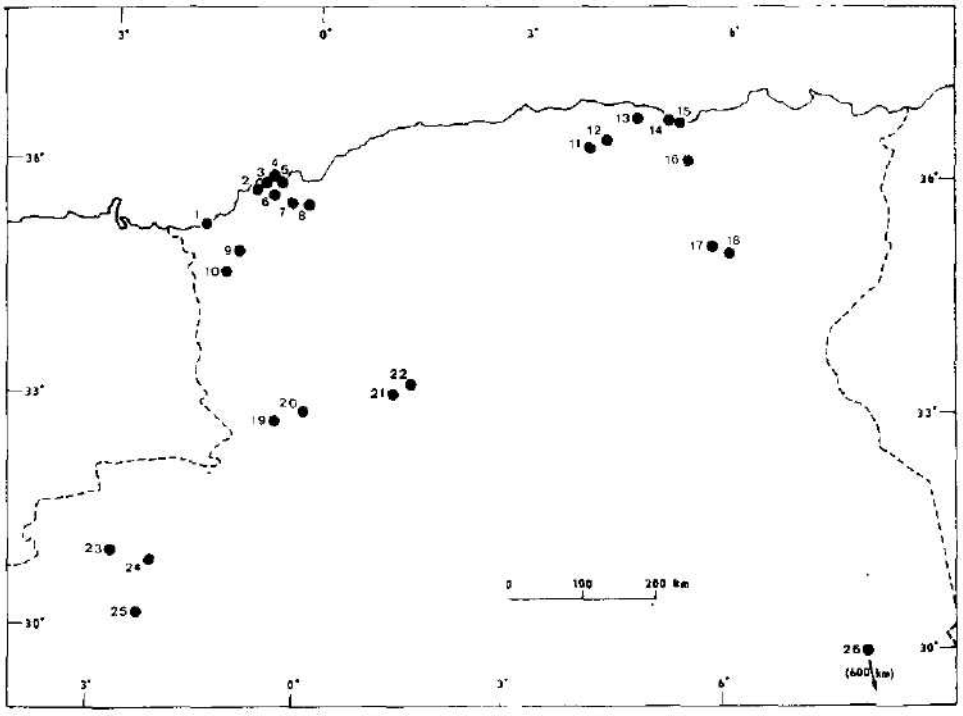

Fig. 1. Localities of positive netting: 1, Honaine; 2. Msila Forest; 3, Mourdjadjo 4, Madakh; 5, Oran; 6, Misserghin; 7, Oued Tlelat; 8, Sig; 9, Tebbar; 10, Sebdou 11, Bouira; 12, Tikjda; 13, Yakouren; 14, Tichi; 15, Aokas; 16, Setif; 17, Amentane; 18 Kef Larous; 19, Ain-El-Hadjadj; 20 Ain Ouarka; 21, Brezina; 22, Arbaouats; 23 Abadla; 24, Taghit; 25, Beni Abbès; 26, Djanet.

Tab. 1. Results of netting in area A, Oran and environs.
Key: 1—8 = localities (cf. Fig. 1); a = relative abundance computed by dividing the number of individuals of each species by the number of net-nights in the area times 100

Species	Sex	1	2	3	4	5	6	7	8	Total	a
R. blasii	♂				1					2	8
	♀	1									
R. ferrumequinum	♂								1	3	11
	♀			1			1				
M. blythi	♂						5			14	54
	♀						9				
M. emarginatus	♀				1					1	4
P. pipistrellus	♂						2			2	8
P. kuhli	♂		2			1	2			16	61
	♀						5	6			
E. serotinus	♂						30			49	188
	♀						19				
M. schreibersi	♂						2			6	23
	♀	1					3				
Total of bats		2	2	1	2	1	78	6	1	93	357
Total of net-nights		5	2	0.5	4	0.5	12	1.5	0.5	26	—

is the number of nets used for one netting multipled by 1 if the netting was done all night, or multipled by 0.5 if it was discontinued before midnight. Total relative abundance is the sum of relative abundances of all species in a certain area.

Areas and their bat communities

Area A, Oran and environs, locality 1 — 8 (Tab. 1): Locality 1, Honaine — at sea shore near the mouth of a brook, 2 nettings. Loc. 2, Msila Forest — over irrigation basins in fields within the forest, 1 netting. Loc. 3, Mourdjadjo — in a canyon overgrown with shrubs, 1 netting. Loc. 4, Madakh — over a brook flowing into the sea, 2 nettings. Loc. 5, Oran — in the city, near a building housing a colony of *P. kuhli*, 1 netting. Loc. 6, Misserghin — two different places, Ravin de la Vierge and a farm west of the town, in both cases over irrigation basins among orchards, 8 nettings. Loc. 7, Oued Tlelat — over a ditch in fields, 2 nettings. Loc. 8, Sig — on the bank of a dam, about 500 m from the entrance to a cave, 1 netting. *E. serotinus* is markedly predominant in the sample from area A. Both faunal size, 8, and total relative abundance, 357, are great as compared to most of the other areas.
Area B, Tlemcen Mountains, localities 9 and 10 (Tab. 2): Locality 9, Tebbar — over a mountain brook, about 900 m above sea level, 1 netting. Loc. 10, Sebdou — among limestone rocks in a forest, twice only over a permanent stream Tafna, once over a brook, at the entrance to a small cave, and in the forest, always at about 900 m a. s. l., 3 nettings. No species is markedly predominant in the sample, *P. pipistrelus*, *M. blythi* and *M. capaccinii* are the most numerous. Faunal size is great, 8, total relative abundance average, 334.
Area C, Djurdjura, localities 11 and 12 (Tab. 2). Locality 11, Bouira — at the outskirts of the town at the foot of the Djebel Djurdjura, above water in the river, about 530 m a. s. l., 1 netting. Loc. 12, Tikjda, below a site called Point de Vue du Djurdjura — over a small lake and at the entrance to a limestone cave, at the altitude of 1600 m, 3 nettings. *P. savii* is predominant, faunal size 5 only, but total relative abundance is very high, 499.
Area D, Yakouren Forest, locality 13 (Tab. 3): This locality is very different from the previous ones and was therefore separated from area C, although it is situated

Tab. 2. Results of netting in areas B, Tlemcen Mountains, and C, Djurdjura.
Key: 9, 10 = localities in area B; 11, 12 localities in area C; a = relative abundance; for details refer to Tab. 1

Species	Sex	9	10	Total	a	11	12	Total	a
R. hipposideros	♂		3	3	37				
R. ferrumequinum	♂		1	1	12				
M. blythi	♂	2	1	5	62	1	4	6	100
	♀	1	1				1		
M. capaccinii	♂		3	5	62				
	♀	1	1						
P. pipistrellus	♂		1	7	87				
	♀		6						
P. kuhli	♂			4	50	1		2	33
	♀		4			1			
P. savii	♂						10	14	233
	♀					1	3		
E. serotinus	♂			1	12	1	1	2	33
	♀	1							
P. austriacus	♂						1	6	100
	♀						5		
M. schreibersi	♀		1	1	12				
Total of bats		5	22	27	334	5	25	30	499
Total of net-nights		1	7	8	—	2	4	6	—

Tab.3. Results of netting in areas D, Yakouren Forest, F, Setif, and G, Aurès.
Key: 13 = locality in area D; 16 = locality in area F; 17, 18 = localities in area G; a = relative abundance; for details refer to Tab. 1

Species	Sex	13	a	16	a	17	18	Total	a
M. blythi	♂	2	31						
M. nattereri	♀	1	15						
P. pipistrellus	♂	4	108	10	53		1	1	14
	♀	3		6					
P. kuhli	♂	1	61	12	60				
	♀	3		6					
P. savii	♂				3	2		5	71
	♀			1		3			
N. leisleri	♂	4	92						
	♀	2							
E. serotinus	♂					13		15	214
	♀					2			
P. austriacus	♂			5	20				
	♀			1					
T. teniotis	♂					7		7	100
Total of bats		20	307	41	136	27	1	28	399
Total of net-nights		6.5	—	30	- -	5	2	7	—

Tab. 4. Results of netting in areas H, Saharian Atlas, and I, Western Erg.
Key: 19—22 = localities in area H; 23—25 = localities in area I; a = relative abundance; for details refer to Tab. 1

Species	Sex	19	20	21	22	Total	a	23	24	25	Total	a
R. mehelyi	♀			2		2	11					
R. blasii	♂		1			2	11					
	♀	1										
R. hipposideros	♀			1		1	5					
R. ferrumequinum	♂			3		3	16					
A. tridens	♂		16	1		20	108	1			3	40
	♀		3							2		
P. kuhli	♂			9	1	13	70	1	1	1	5	67
	♀			3					1	1		
P. deserti	♀								1		1	13
P. rueppelli	♂							1		1	3	40
	♀							1				
E. serotinus	♂				1	2	11					
	♀	1										
O. hemprichi	♂			1		1	5	1			7	93
	♀							3		3		
P. austriacus	♂			6		11	59					
	♀			5								
Total of bats		2	20	31	2	55	296	8	3	8	19	253
Total of net-nights		2	1.5	12	3	18.5	—	4	1	2.5	7.5	—

nearby (cf Fig. 1). Bats were netted in a relatively well- preserved forest of *Quercus suber, Q. afares* and other broadleaved trees, over a small brook polluted by the sewage of the village Yakouren, altitude 820 m, 4 nettings. *P. pipistrellus* was predominant, the next most numerous species being *N. leisleri* which had not yet been found anywhere else in the Maghreb. The find had already been reported by Hanák and Gaisler (1984), but then they had only males. The new material of 2 females, one of them juvenile (11 August), confirms the presumption that *N. lei-*

Tab. 5. Species diversity of the areas and foraging diversity of the species.
Both based on the relative abundance of species in the areas and expressed by H′

Area	H′	Species	H′
A, Oran and environs	2.02	*R. blasii*	0.99
B, Tlemcen Mountains	2.73	*R. hipposideros*	0.53
C, Djurdjura	1.98	*R. ferrumequinum*	1.41
D, Yakouren Forest	2.06	*A. tridens*	0.84
F, Setif	1.57	*M. blythi*	1.94
G, Aurès	1.58	*P. pipistrellus*	1.88
H, Saharian Atlas	2.48	*P. kuhli*	2.75
I, Western Erg	2.09	*P. deserti*	0.19
		P. savii	0.85
		E. serotinus	1.57
Note: Species diversity does not apply to the areas E and J, but the samples from these areas were used when calculating foraging diversity		*O. hemprichi*	0.28
		P. austriacus	1.34
		M. schreibersi	0.92

sleri breeds in northern Africa. Faunal size is 5 species in this area, total relative abundance 307, i. e. medium.

Area E, Corniche Kabyle, localities 14 and 15: Only two nettings were done in this area of many caves (for details see Gaisler, 1983), at the entraces to and in the vicinity of small caves near Tichi (locality 14) and Aokas (loc. 15). No colonies were found in the caves. The sample consists of only 1 ♂ and 1 ♀ *R. ferrumequinum*. There were 2.5 net-nights; relative abundance 80.

Area F, Setif, locality 16 (Tab. 3): Bats were netted over and in the vicinity of a small muddy pond, in a neglected park near the centre of the town with 350 000 inhabitants, at the altitude of 1090 m. Much of our netting was done there, 18 times with good results, 9 times without catching any bats. Other fruitless nettings were done in the vicinity of the town. *P. kuhli* and *P. pipistrellus* are predominant in the sample. Both faunal size, 4, and total relative abundance, 136, are low.

Area G, Aurès, localities 17 and 18 (Tab. 3): Locality 17, Amentane — a rocky canyon near a small palm grove, above the water of an almost dried-up brook, about 700 m a. s. l., 1 netting. Loc. 18, Kef Larous — in a similar terrain, but over a rapidly flowing brook, about 700 m a. s. l., 1 netting. *E. serotinus* is predominant, the second most numerous species is *T. teniotis* caught at locality 17 but also observed at loc. 18. Faunal size is low (4), total relative abundance high (399).

Area H, Saharian Atlas, locality 19 to 22 (Tab. 4): Locality 19, Ain-El-Hadjadj — in the bed of a flowing brook at the outskirts of the oasis, 1070 m a. s. l., 1 netting. Loc. 20, Ain Ouarka — entrance to a cave in a rocky terrain, about 1200 m a. s. l., 2 nettings. Loc. 21, Brezina — in a rocky ravine with stagnant water and at the foot of slopes along a broad dry wadi, about 1500 m a. s. l., 5 nettings. Locality 22, Arbaouats — in a niche below a rock, about 1300 m a. s. l., 2 nettings. *A. tridens* is predominant in the material owing to our sampling a small colony living in the cave at loc. 20; otherwise, *P. kuhli* and *P. austriacus* are predominant. Faunal size is the highest of all areas (9), total relative abundance rather low (296).

Area I, Western Erg, locality 23 to 25 (Tab. 4): Locality 23, Abadla — at the outskirts of the oasis, above and around saltwater pools in an otherwise dry bed of the river Oued Guir; tamarisks and other xerophilous vegetation, 1 netting. Loc. 24, Taghit — palm grove in the oasis, over an irrigation basin full of water, 1 netting. Loc. 25, Beni Abbès — at the outskirts of the oasis, in the bed of the Oued Guir, above water and among vegetation, 2 nettings. *O. hemprichi* and *P. kuhli* are predominant. Faunal size 5, total relative abundance low, 253.

Area J, Djanet, locality 26: The only locality in southern Algeria; unfortunately, only one short netting was possible in the oasis, over an irrigation basin (1 net, 1 hour). 1 ♂ and 1 ♀ *P. deserti* were caught, relative abundance 400.

Species and foraging diversity

In comparing the samples from individual areas we must take into account distortions due to the different sizes of the areas, different numbers of localities in them, different numbers of net-nights, and other factors determining the success of netting. Nevertheless, the data summarized in Tab. 1 — 4 show that neither faunal size nor relative abundance are correlated with the number of localities and net-nights in individual areas. Omitting areas E and J, where there were too few net-nights, we arrive at the following order: faunal size H, A, B, C, D, I, F, G; total relative abundance C, G, A, B, D, H, I, F (each from the highest to lowest value).

The values of the relative abundance of each species have been used for the calculation of species diversities of the samples from the individual areas. The species diversities are expressed by Shannon-Weaver index H' using $\log_2 p_i$ (for details see Gaisler 1979). As shown in Tab. 5, the highest diversity occurs in area B, followed in descending order by areas H, I, D, A, C, G and F. On the whole, samples from western Algeria (B, H, I, A) display a higher diversity than those from the eastern part of the country, where diversity is great only in the sample from area D, Yakouren Forest.

A comparison of the orders of the samples by faunal size, species diversity and total relative abundance shows that only area B is above average by all these three criteria, and area F is the only one below average. Presuming that our samples at least partially reflect reality, the community of foraging bats in the Tlemcen Mts. appears to be numerous, well-balanced, comprising many species, whereas on the plateau of Setif and in its environs there are few species of few individuals. This assumption seems to be correct especially in the latter case, considering the position of sample F by all three criteria, and the high number of negative nettings in Setif and environs.

Besides species diversities, Table 5 includes foraging ones. They have been calculated after Kunz (1973) by comparing the relative abundance of a species in a certain area with the sum of relative abundances of the same species in all areas. These values have been substituted into Shannon-Weaver index H'. The order of species by the values of foraging diversity is, as follows: *P. kuhli, M. blythi, P. pipistrellus, E. serotinus, R. ferrumequinum, P. austriacus, R. blasii, M. schreibersi, P. savii, A. tridens, R. hipposideros, O. hemprichi* and *P. deserti*. Diversity cannot be calculated for the remaining seven species, because the have been found in only one area each.

Comments on activity

Although netting is not a perfect method for getting a clear picture of the activity of foraging bats (cf. Kunz and Brock 1975, Erkert 1982), our material offers a few insights into the amount of activity in the course of year and night. The success or failure of our 126 nettings, grouped by months, is shown in Fig. 2. The diagram is not based on the values of relative abundance, but on 1 netting per locality, disregarding the number of nets or whether the

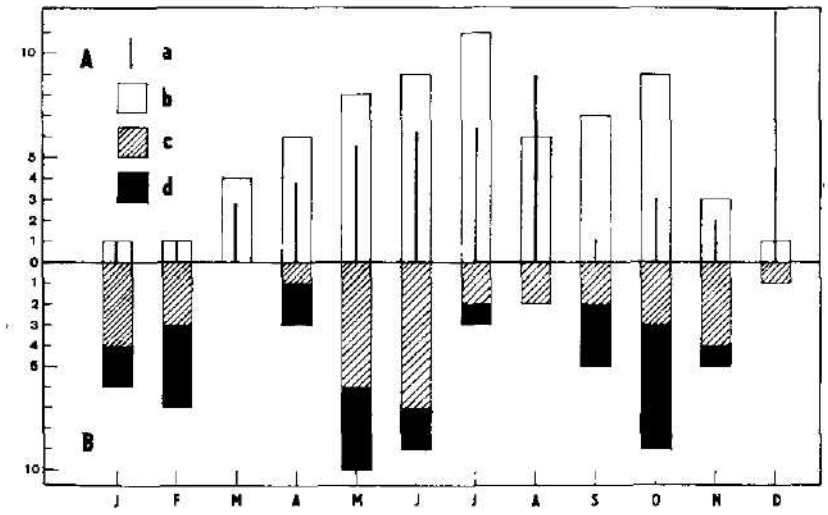

Fig. 2. Success (A) and failure (B) of nettings during a year. Key: ordinate = number of nettings or relative number of bats netted; abscissa = months; a = number of bats per one netting at one locality; b = number of positive nettings; c = number of negative nettings but flying bats observed; d = number of nettings with no bats at all.

netting continued all night or a shorter time. The diagram shows that failures occurred throughout the year, but compared with successes their number was especially high in January and February. On the other hand, flying bats were sighted in the two months. Netting was increasingly successful approximately from March to July, the number of captured bats per netting increased from March to August. The proportion of successful nettings and captured bats greatly varied in the second half of the year. There seems to be a distortion due to few nettings in December, one of which was (accidentally?) very productive. Nevertheless, it is quite clear that bats fly throughout the year, but their activity is low in January and February. The decrease in activity occurs not only in the northern coastal area, but also in oases in the Sahara, such as Laghouat, Ghardaia, Timimoun, El Wad, Wargla and Tamanrasset, where we netted in those months without capturing any bats.

The course of nocturnal activity can be estimated only by those positive nettings which continued till sunrise, and during which the time of each capture was recorded. There were 18 such nights in areas A, B, C, F, G, H, I from April to November. As no substantial differences ensued from the comparison of samples by areas, the material has been examined by months. Each night has been divided into 8 identical parts as in G a i s l e r (1973). The results (Fig. 3) show unimodal activity in April and May, reaching its peak in

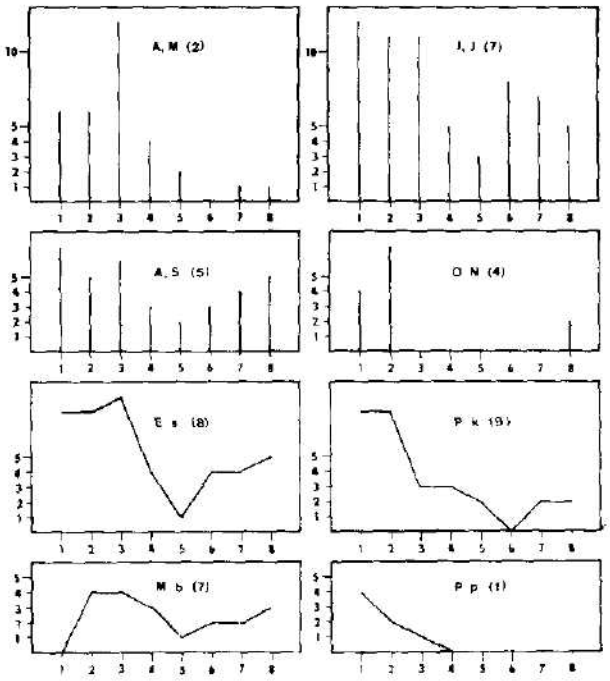

Fig. 3. Distribution of catches in 18 nettings with recorded time of individual captures during the whole night. Key: ordinate = number of bats; abscissa = eight parts of a night; A, M, J, J, A, S, O, N = months; E. s. = *E. serotinus;* P. k. = *P. kuhli;* M. b. = *M. blythi;* P. p. = *P. pipistrellus;* (in parentheses the number of nights). Further details in the text.

the third part of the night, and bimodal activity in the other months. In June — July and August — September, captures were minimal in the fifth part of the night, i. e. after midnight.

Fig. 3 also shows a sample of the four most numerous species, which covers the period from April to November. The activity of *E. serotinus*, *P. kuhli* and *M. blythi* is bimodal, in *M. blythi* beginning later in the night than in the other two species. In *E. serotinus* and *M. blythi*, activity is minimal immediately after midnight, in *P. kuhli* only in the sixth part of night. *P. pipistrellus* was caught only at the beginning of the night. It should be emphasized that in our material there is no species that would have been caught only in the second half of night. *A. tridens*, *M. blythi*, *M. capaccinii*, *P. kuhli*, *P. savii*, *E. serotinus*, *O. hemprichi*, *P. austriacus*, *M. schreibersi* and *T. teniotis* were caught before and after midnight, the other species before midnight only. The sample of a single species, *M. capaccinii*, was larger in the second half of the night (4 against 1 individual).

DISCUSSION

Species composition, abundance and diversity

As concerns species composition, there is a marked difference between samples from individual climatic zones according to the bioclimatic division of Algeria (cf. Ledant et al. 1981). *P. pipistrellus*, *M. blythi*, *M. schreibersi* and the rarer *M. capaccinii*, *M. emarginatus*, *M. nattereri* and *N. leisleri* are characteristic of the northern (Mediterranean) zone where the climate is mostly subhumid. It includes area A to F. Most of our material of *E. serotinus* and *P. savii* comes from this zone. The species composition of samples from the Saharan zone of desert climate, where areas I and J are situated, is quite different. The characteristic species are *O. hemprichi*, *A. tridens*, *P. rueppelli* and *P. deserti*. Between these two extremes there is a zone of mountain steppe, semiarid to arid, containing areas G and H. The intermediate character of our samples is in keeping with the climate: they include species abundant in the north, such as *E. serotinus*, *P. pipistrellus* and *P. austriacus*, as well as the southern desert species *A. tridens* and *O. hemprichi*. There is also a considerable difference between the samples from areas G and H in their species compositions. Although the difference cannot be ascribed to endemism it may reflect the distinctions of the biotopes of the Saharian Atlas and Aurès.

Values of the relative abundance of individual species range between 3 and 233 if the relative abundance of *P. deserti* in area J (400) is not taken into account, being of low significance. The ascertained values are similar to those given by Kunz (1973) for central Iowa. Although one superabundant species predominates in some of the samples, in most the representation of individual species is rather equable. This is in keeping with Humphrey's (1975) observation that the equitability of summer netting samples is usually high. According to this author, "the most summer bat communities follow the usual pattern of having a few abundant species, a moderate number of common ones, and many rare ones". A perfect example of this is the sample from area A, which is the most representative in our material, containing the abundant species *E. serotinus*, common *P. kuhli* and *M. blythi*, and five rare species. Also the values of species diversity determined by us agree with published data based on netting samples (Fleming et al. 1972, Kunz 1973, Hump-

hrey 1975, Gaisler 1979). The H' of these samples mostly range between 1.5 and 2.5. The high value of 2.73 in the sample from area B is probably due to the great environmental diversity of the localities in the Tlemcen Mts. — rocks and caves, forest, permanent river, while the low value of the H' index found in area F may be the consequence of a low environmental diversity in Setif and environs, which is an agricultural region without any caves, with very few trees, and heavy erosion.

Kunz (1973) reported the foraging diversity of 0.68 — 1.48 for eight species in three areas in central Iowa. Our material covers a greater range, from 0.19 to 2.75, which is natural considering the greater size and diversity of the territory explored by us. *P. kuhli* displays the greatest foraging diversity, which seems to manifest the near-ubiquitousness of this species in northern Africa. It is the only species in our sample which occurs in the Mediterranean as well as desert zones. The next two species, *M. blythi* and *P. pipistrellus*, are confined to the north; *E. serotinus*, the fourth in the order of foraging diversity, was also abundant in the Aurès mountains. *R. ferrumequinum* and *P. austriacus* were found in the Mediterranean zone and in the Saharian Atlas. The rest, species of $H' < 1$, appear to be stenotopic, confined to specific kinds of environment.

Our samples also show differences in the hypsometric distribution of species. Among the species of high foraging diversity, *P. kuhli* and *M. blythi* frequently occurred in lowlands, *P. pipistrellus* at higher altitudes, and *E. serotinus* was as abundant in lowlands as in mountains. *R. ferrumequinum* was found in lowlands as well as in mountains, but only in areas where there were caves. *P. austriacus* was found only in mountains or on plateaux. Data on the species of low indices of foraging diversity are less significant, with the exception of *P. savii* which seems to prefer montane regions (in keeping with Hill 1964, Vaughan et al. 1977, Gaisler 1983). We caught *P. savii* at the altitude of 530 to 1600 m.

Activity

The fact that the nocturnal activity of bats as revealed through mist netting continues throughout winter months has been discussed for northern Algeria in previous papers by Gaisler (1983, 1984). The sample collected from a larger area, summed up in the present paper, confirms these observations and shows that activity is low in winter not only in the north but in the desert zone as well. Similarly, O'Farrell et al. (1967) found that some species of bats in the Nevada desert are active throughout autumn and winter, but that activity is reduced during these seasons. Bradley and O'Farrell (1969) studied the activity of *Pipistrellus hesperus* and found that from December to March, activity at a desert spring is mainly concentrated in the 2 hours after sunset. *P. hesperus*, according to these authors, do not enter in prolonged periods of hibernation. In our material, the only species active (netted) from December to February were *P. pipistrellus*, *P. kuhli* and *P. austriacus*. *E. serotinus* and *M. schreibersi* in the north and *P. deserti* in the (netted) from December to February were *P. pipistrellus*, *P. kuhli* and *P.* desert were netted in March.

Many studies have shown that temperature and other climatic factors affect the seasonal and daily rhythms of activity (Erkert 1982). Our occasional measurements of temperature and weather records are insufficient for exact

evaluation of the complex question of winter activity. It should be noted, however, that the failure of our netting in desert areas cannot be ascribed to low temperature, as follows from these examples: 6 February 1983, Guelta Imlaoulaouene, Hoggar — warm night, no bats were flying; 8 February 83, 60 km S of Tamanrasset — warm night, 1 flying bat, no capture; 11 February 83, Gorges d'Arak by the road In Salah — Tamanrasset — warm night, no bats were flying. The question what inhibits the activity of bats in the Sahara in winter remains open to further research.

As concerns the nocturnal rhythm of activity, our findings confirm those published by many other authors, i. e. that activity is highest at the beginning (O'Farrell et al. 1967, Hall and Brenner 1968, Bradley and O'Farrell 1969, La Val 1970, Gaisler 1973, Kunz 1973, Fenton and Thomas 1980). Our samples covering June — November and the species *E. serotinus*, *P. kuhli* and *M. blythi* show bimodal activity with the minimum after midnight. Also this observation confirms data in literature (Aellen 1962, O'Farrell et al. 1967, Kunz 1973, Kunz and Brock 1975, Fenton et al. 1977, Fenton and Thomas 1980). According to Eckert (1982), "bimodal activity patterns are characteristic of almost all insectivorous species ... the main peak is at the beginning of the activity phase in each case and the secondary peak is usually toward the end". However, these authors also found differences in the activity of some species. This corresponds with our observations of an earlier onset of activity in the genus *Pipistrellus* and in *E. serotinus* than in the *Myotis* bats. These questions are often discussed in connection with the feeding strategy of individual sympatric species. According to Fenton and Morris (1976) and Fenton and Thomas (1980), most insectivorous bats are opportunistic feeders but opportunistic feeding is not incompatible with selective feeding. Kunz (1973) has pointed out that the species showing overlap in temporal foraging may have evolved other strategies to reduce competition for resources.

During the netting we also noted the manner of flight of the bats. Most species could not be distinguished at a distance, but those which could differed in their ways of flying. Extreme cases were *O. hemprichi* which flew low ower the desert and among shrubs, and *T. teniotis* which hunted high in the air. Therefore we agree with the view that the mechanisms by which sympatric species partition environmental resources are diverse. The likelihood of capturing different species in nets is connected with their different ways of flying. Similarly as other authors, we tried netting over water whenever possible, but the success of netting over water may sometimes reflect drinking rather than hunting activity of bats. Some of our samples and the samples of other authors obtained by netting over water probably do not consist of individuals from communities of hunting bats (as usually stated) but from communities of hunting and/or drinking bats.

SUMMARY

186 males and 131 females of 20 bat species were caught in nets in three climatic zones of Algeria from June 1980 to September 1983. The following numbers of species and predominant species were found in samples from individual areas: Oran and environs — 8 species, *E. serotinus* predominant; Tlemcen Mts. — 8 species, none predominant; Djurdjura — 5 species, *P. savii* pre-

dominant; Yakouren Forest — 5 species, *P. pipistrellus* predominant; Setif — 4 species, *P. kuhli* predominant; Aurès — 4 species, *E. serotinus* predominant; Saharian Atlas — 9 species, *A. tridens* and *P. kuhli* predominant; Western Erg — 5 species, *O. hemprichi* and *P. kuhli* predominant. The highest relative abundance with regard to the number of net-nights appeared in the sample from Djurdjura, the greatest species diversity in the sample from the Tlemcen Mts. The lowest relative abundance as well as diversity were found in the sample from Setif. There was a qualitative difference between samples from the northern, Mediterranean zone and those from the desert (only 1 common species); samples from the mountain steppe zone were of an intermediate character. The greatest foraging diversity was found in the ubiquitous *P. kuhli*. Among other species of great foraging diversity, *E. serotinus* and *R. ferrumequinum* occured in lowlands as well as mountains, *M. blythi* at low altitudes, *P. pipistrellus* and *P. austriacus* at higher ones. *O. hemprichi*, *A. tridens*, *P. rueppelli* and *P. deserti* were found only in the south, the rest nowhere but in the north. The percentage of captures and the numbers of sighted bats were lowest in January and February, increasing from March to July and showing much variation from August to December. The incidence of captures in the course of night indicates that in most species activity reaches its maximum at the beginning of the night, and in several species there is another, lower peak of activity before dawn.

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MORPHOMETRICAL NOTE ON THE CHUB (LEUCISCUS CEPHALUS, PISCES: CYPRINIDAE) FROM THE RESERVOIR KLÍČAVA (CZECHOSLOVAKIA)

Lubomír HANEL

Received September 30, 1985

Dedicated to Asst. Prof. Dr. Ota Oliva on the occassion of the 60th anniversary of his birthday

A b s t r a c t. Plastic and meristic characters of 100 specimens of the chub, *Leuciscus cephalus* (Linnaeus, 1758), 20—320 mm of the body length, from the reservoir Klíčava (Central Bohemia) are described and discussed. Obtained values are compared with those from other European drainages using literary data (Drainage of the Labe 148 specimens, drainage of the Dunaj 595 sp., drainage of the Odra 290 sp., drainage of the Tisa 456 sp., drainage of the Vistula 564 sp., and drainage of the Niemen 44 sp.)

INTRODUCTION

Five subspecies of the chub (see O l i v a, H r a b ě, L á c, 1968) are described and recognized: *Leuciscus cephalus cephalus* Linnaeus, 1758; *Leuciscus cephalus cabeda* Risso, 1828: *Leuciscus cephalus albus* Bonaparte, 1838; *Leuciscus cephalus orientalis* Nordmann, 1840; *Leuciscus cephalus pyrenaicus* Günther, 1863. Morphometrical studies about the chub in Czechoslovak waters were published by L i b o s v á r s k ý (1956), O l i v a, Š a f r á n e k (1961), D o r k o (1964), small notes about plastic or meristic characters are given in M a h e n (1930), D y k (1946, 1952), B a l o n (1952), O l i v a (1952 a b; 1953 a, b), R o m a n o v s k ý (1952), F r a n k et al. (1962), L e o n t o v y č (1968), P e c l (1969), H a n e l (1982). L u s k, P o k o r n ý (1964) studied the changes of the body weight and some other dimensions of the chub in 4 % formalin solution. Morphometrical data in above mentioned papers are based on materials originated exclusively from rivers. Therefore is useful to compare morphometrical values of the chub living in rivers and stagnant water in the reservoirs.

MATERIAL AND METHODS

The sample of 100 specimens of the chub from the valley water reservoir was collected using gill nets or seine nets. Fish were conserved in 4 % formalin and later after washing in clear tap water they were transferred into 70 % alcohol. The sample was collected in following years: 1962 (September, 24.—29.), 1964 (April, 23., October, 8.—10.), 1980 (August, 5.). For the method of the measurement see O l i v a (1953 b). For comparison data from following localities were used:

1. the drainage of the river Labe
the Labe drainage (the reservoir Slapy, the middle part of the river Labe, Labe drainage) (O l i v a, Š a f r á n e k, 1961), no. of examined specimens 148;

2. the drainage of the river Dunaj
the river Bečva (Oliva, 1952a), no. of specimens 10 (73—130 mm of the body length); the Dunaj drainage (the rivers Bečva ,Dunaj, Dyje, Hornád, Laborec, Malý Dunaj, Morava, Orava, Vah, Zazrivá, the brook Lutylovský potok, the reservoir Vranovská přehrada) (Oliva, Šafránek, 1961), no. of specimens 154; the river Morava (Oliva, 1952b), no. of specimens 7 (138—220 mm of the body length); the rivulet Přímda (Frank et al., 1962), no. of specimens 6 (86—117 mm of the total length); the river Svratka (Libosvárský, 1956), no of specimens 257 (81—313 mm of the body length); the river Turiec (Krupka, 1969), no. of specimens 161 (age O.—X.),

3. the drainage of the river Odra
the rivers Odra and Moravice (Oliva ,1953b), no of specimens 3 (106—134 mm), the Odra drainage (the rivers Lučina, Moravice, Olza, Stonávka) (Oliva, Šafránek, 1961), no of specimens 287;

4. the drainage of the river Tisa
the Ondava drainage (the river Ondava, rivulets Ladomírka, Chotčianka) (Dorko, 1964) ,no. of specimens 415 (mean 121 mm of the body length), the Tisa drainage (the brook Driekovský potok) (Oliva, Šafránek, 1961), no of specimens 41,

5. the drainage of the river Vistula
the river Bukowa (Lewandowska-Jarzynowa, 1969), no. of specimens 12 (age III_+ — VI_+); the river San (Rolik, 1962), no. of specimens 91 (80—320 mm); the river San (Klimczyk , 1965), no. of specimens 131 (age 2—7); the river Soła (Klimczyk, 1965), no. of specimens 23 (age 1—6), the river Tanew (Lewandowska-Jarzynowa, 1969), no. of specimens 174 (100—358 mm), the river Vistula (Klimczyk, 1965), no. of specimens 90 (age 2—9); the river Vistula (Rolik, 1962), no. of specimens 29 (80—360 mm); the river Wirowa (Lewandowska-Jarzynowa, 1969), no. of specimens 14 (age IV_+ — VII_+);

6. the drainage of the river Niemen
the river Niemen (Žukov, 1958), no. of specimens 44.

My material and some other materials of the chub are deposited in the collections of the Dept. Syst. Zool Fac. Sci. Charles University, Prague.

RESULTS AND DISCUSSION

A) Meristic characters

1) Number of scales in the lateral line

I have found 42 scales in 13 % from all examined specimens, 43 scales in 8 %, 44 scales in 27 %, 45 scales in 27 %, 46 scales in 21 %, 47 scales in 2 % and 48

Table 1. Meristic characters of the chub (*Leuciscus cephalus*) from the reservoir Klíčava

Number of rays	ranges	mean
in D (unbranched/branched rays)	2/7—10	2/8.39
in A (unbranched/branched rays)	2—3/7—10	2/8.57
in P (all rays)	13—18	15.35
in V (all rays)	8—10	8.97
number of scales		
in the lateral line	42—48	43.95
above the lateral line	7—8	7.63
below the lateral line	3—4	3.96
number of gill rakers on the 1st gill arch (outer/inner gill rakers)	7—11/12—13	9.14/12.14

Table 5. The meristic characters of the chub (*Leuciscus cephalus*) from different localities (the drainage of the river Labe)

locality	author	no. of scales in l.l.	no. of rays in D	no. of rays in P	no. of rays in V	no of rays in A	scales above l.l.	scales below l.l.	no. of gill rakers
Labe drainage	Oliva, Šafránek (1961)	43—48 (44.9)	7—9 (7.9)	—	—	7—10 (8.2)	—	—	—
reservoir Klíčava	own values	42—48 (43.9)	2/7—10 (8.4)	13—18 (15.4)	8—10 (8.9)	2—3/7—10 (2.01/8.6)	7—8 (7.6)	3—4 (3.9)	7—11/12—13 (9.1/12.1)

Table 6. The meristic characters of the chub (*Leuciscus cephalus*) from different rivers (the drainage of the river Vistula)

locality	author	no. of scales in l.l.	no of. rays in D	no of rays in P	no. of rays in V	no. of rays in A	scales above l.l.	scales below l.l.	no. of gill rakers
river San	Rolik (1962)	41—46 (44.3)	3/7—8 (7.9)	—	—	3/7—9 (8.4)	7—8 (7.4)	3—4 (3.4)	8—11 (9.2)
river San	Klimczyk (1965)	44—46 (45.1)	8—9 (8.8)	15—18 (16.3)	7—9 (8.0)	8—9 (8.9)	6—8 (6.9)	2—4 (3.0)	8—11 (9.2)
river Sola	Klimczyk (1965)	44—46 (45.2)	8—9 (8.8)	16—17 (16.2)	7—9 (7.9)	8—10 (9.0)	6—7 (7.0)	2—3 (2.9)	8—10 (9.1)
river Vistula	Rolik (1962)	43—46 (44.7)	8	—	—	8—9 (8.4)	7—8 (7.2)	3—4 (3.1)	8—11 (9.0)
river Vistula	Klimczyk (1965)	44—46 (45.1)	8—9 (8.7)	15—17 (16.1)	7—9 (8.0)	8—9 (8.9)	6—8 (7.0)	3—4 (3.1)	7—11 (9.0)
rivers Tanew, Wirowa Bukowa	Lowandowska-Jarzynowa (1969)	44—47 (45.2)	3/8 rarely 7 or 9	—	—	3/8—9 (8.5)	mostly 7	3	—

Table 3. The meristic characters of the chub (*Leuciscus cephalus*) from different rivers (the drainage of the river Dunaj)

locality	author	no. of scales *in l.l.*	no. of rays in *D*	no. of rays in *A*	scales above *l.l.*	scales below *l.l.*	no. of gill rakers
river Bečva	Oliva (1952a)	42—45 (44.1)	3/8	3/8	7—8	3—4	—
Dunaj drainage	Oliva, Šafránek (1961)	42—48 (44.8)	7—9 (7.9)	7—9 (7.9)	—	—	—
river Morava	Oliva (1952b)	43—45 (43.9)	3/8	3/9	—	—	—
river Přímda	Frank et. al. (1962)	45—46 (45.5)	7—9 (8.2)	8—9 (8.6)	—	—	—
river Svratka	Libosvárský (1956)	43—47 (44.2)	7—8 (7.9)	7—9 (8.0)	7—9 (7.7)	3—5 (3.8)	—
river Turiec	Krupka (1969)	44—48 (45.6)	3/7—8 (7.8)	3/7—8 (7 6)	7—8 (7.6)	4	7—10 (9.0)

scales in 2 %, as well. The mean is 43.95, standard deviation calculated from this sample s = 1.41060. The ranges from different drainages are similar (see Tab. 1—6) (Labe 42—48, Odra 42—49, Dunaj 42—48, Tisa 42—47, Vistula 41—47, Niemen 42—47). the same as their means (Odra 44.2, Labe 44.4, Dunaj 44.7, Tisa 44.9, Vistula 44.9, Niemen 45.0). It is evident that mostly 44—45 scales in the lateral line were found in drainages of the Labe and Dunaj, 45—46 scales in drainages of the Tisa, Odra and Vistula. Less than 42 scales in the lateral line (41) were found only in two specimens of the chub of the *nominal form* from the river San (Rolik, 1962). Oliva, Šafránek found 49 scales in the lateral line in the river Odra in one specimen; this number was also cited by Dyk (1946) and Mahen (1930).

2) Scales below the lateral line

In examined material the number of scales below the lateral line was 3—4, the mean 3.96 (4 % of the specimens had 3 and 96 % had 4 scales below the lateral line). In the rivers Svratka and Turiec (the drainage of the river Dunaj) 3—5 scales (the mean 3.9) were found. In the rivers Niemen and Ondava 3—4 scales (the mean 3.3) were found, in the drainage of the river Vistula 2—4 (the mean 3.1). Only 2 scales below the lateral line in the rivers Soła and San were found,

Table 4. The meristic characters of the chub (*Leuciscus cephalus*) from different localities (the drainage of the river Odra)

locality	author	no. of scales in l.l.	no. of rays in dorsal fin	no. of rays in anal fin
the Odra drainage	Oliva, Šafránek (1961)	43—49 (45.4)	6—9 (7.9)	7—9 (8.0)
rivers Odra and Moravice	*Oliva (1953b)*	42—44 (43.0)	3/8	3/8—9 (8.3)

Table 5. The meristic characters of the chub (*Leuciscus cephalus*) from the drainage of the river Tisa and the river Niemen

locality	author	no. of scales in l.l.	no. of rays in D	no. of rays in A	scales above l.l.	scales below l.l.
Ondava	Dorko (1964)	42—46 (44.3)	3/7—9 (8.0)	3/8—9 (8.3)	7—8 (7.3)	3—4 (3.3)
Tisa drainage	Oliva, Šafránek (1961)	43—47 (45.4)	7—9 (7.9)	7—9 (7.9)	—	—
river Niemen	Žukov (1958)	42—47 (45.0)	8—9 (8.1)	8—10 (9.0)	6—8 (6.9)	3—4 (3.3)

5 scales in the river Svratka. Krupka (1969) found 4 scales below the lateral line in all investigated specimens (n = 161).

3) Scales above the lateral line

The number of scales was 7—8, the mean 7.6 (18 % of the specimens had 7 and 82 % had 8 scales above the lateral line). In the drainage of the Dunaj (the rivers Svratka and Turiec) were found 7—9 scales (the mean 7.65). Further data are available from drainages of the Tisa (7—8, the mean 7.3), Vistula (6—8, the mean 7.1) and Niemen (6—8, the mean 6.9).

4) Rays in the dorsal fin

I have found 2 non-branched rays in all specimens in my sample. This is different from the findings of other authors, who studied the number of rays in the dorsal fin. Only Oliva, Hrabě, Lác (1968) and Oliva, Hrabě, Opatrný (1973) cited 2—3 non-branched rays in the dorsal fin. Some authors present only the total number of branched rays in the dorsal fin (see Tab. 2—6). The number of branched rays is 8—9 in most of our specimens, the ranges being from 7—10. The mean is 8.39 (5 % of the specimens had 7 rays, 53 % had 8 rays, 39 % had 9 rays and 3 % of examined specimens had 10 branched rays in the dorsal). Ranges 7—9 were found in the Dunaj and Tisa drainages, 8—9 in the river Niemen, 6—9 in the Odra drainage, 7—10 in the Labe drainage. The mean values are similar (Labe 8.2, Niemen 8.1, Odra, Dunaj and Tisa drainages 7.9). Oliva, Šafránek (1961) found 6 branched rays in the dorsal fin in one specimen from the Odra drainage. 10 branched rays were found in three specimens in my own material.

5) Rays in the anal fin

In my material from the reservoir Klíčava I have found 2—3 non-branched rays in the anal fin, the mean being 2.01 (99 % of the examined specimens had 2 and only 1 % had non-branched rays). 2 non-branched rays were found only in my material. As to branched rays in the anal fin I have counted 7—10, the mean 8.57 (4 % of the specimens had 7, 40 % had 8, 51 % had 9 and 5 % had 10 branched rays in the anal fin). 7—9 branched rays were found in the Odra, Dunaj and Tisa drainages, 7—10 in the Labe drainage and 8—10 in the river Niemen. The mean values are the following: Tisa drainage 8.1, Labe, Odra and Dunaj drainages 8.2, Vistula drainage 8.7 and the river Niemen 9.0.

Table 7. The changes of plastic characters with regard to the size in the chub (*Leuciscus cephalus*) from the reservoir Kličava

Character	length group (mm of BL)	20—120	121—220	221—320
	mean (mm of BL)	85	156	257
	no. of sp.	69	13	18
In % of total length				
	Body length	76.0—85.7 (82.0)	76.0—84.6 (82.4)	79.3—86.8 (82.7)
in % of body length				
	head length	22.5—27.5 (24.5)	19.5—25.9 (23.2)	21.6—25.9 (24.1)
	head depth	14.5—18.6 (16.4)	17.2—19.5 (18.3)	16.5—19.3 (18.1)
	head width	11.4—14.4 (13.1)	10.9—14.7 (13.3)	12.6—15.3 (14.1)
	maximal depth of the body	24.1—25.9 (25.2)	25.9—27.6 (26.8)	24.8—27.2 (26.1)
	interorbital distance	8.1—10.3 (9.3)	10.4—11.6 (10.9)	10.0—10.9 (10.5)
	preorbital distance	6.5—10.7 (7.8)	6.4—9.4 (7.5)	5.1—8.7 (7.8)
	postorbital distance	9.4—13.4 (11.6)	10.5—13.4 (11.8)	9.8—12.8 (11.9)
	eye diameter	4.7—7.4 (5.9)	4.0—5.1 (4.5)	3.7—5.2 (4.5)
	predorsal distance	49.7—58.7 (53.8)	50.5—56.5 (53.1)	48.5—55.9 (53.4)
	postdorsal distance	29.2—39.6 (34.2)	28.6—36.6 (33.5)	29.2—33.9 (32.1)
	preventral distance	46.6—55.6 (51.8)	47.3—54.6 (50.4)	46.7—53.2 (49.6)
	length of the caudal peduncle	14.5—22.1 (18.5)	12.7—22.1 (17.7)	14.6—21.0 (17.6)
	depth of the caudal peduncle	10.1—18.6 (13.5)	10.9—15.0 (13.8)	12.5—14.6 (13.7)
	length of the base of D	7.5—12.7 (10.0)	8.9—11.8 (10.7)	8.9—12.2 (10.8)
	length of the base of A	7.4—12.3 (9.8)	7.8—11.8 (10.2)	8.9—12.6 (11.0)
	length of the longest ray in D	19.0—24.3 (21.1)	12.1—21.8 (19.1)	17.1—20.8 (91.1)
	length of the longest ray in A	12.6—21.2 (17.7)	13.5—18.7 (16.4)	14.3—19.4 (16.6)
	length of P	16.1—21.5 (18.7)	16.0—21.2 (18.9)	17.5—20.7 (19.7)
	length of V	13.6—18.9 (16.4)	13.5—17.4 (15.9)	14.3—17.1 (15.9)
	length of C	17.6—29.3 (21.9)	18.2—23.3 (20.7)	14.6—26.1 (20.5)

6) Rays in the ventral fin

The number of all rays in the ventral fin of the examined sample ranged from 8 up to 10, giving the mean value of 8.97 (12 % of the examined specimens had 8 rays, 77 % had 9 rays and 11 % had 10 rays in the ventral fin). Only from the Vistula drainage I have data for comparison. In this drainage 7—9 rays

Table 8. Growth equations of plastic characters of the chub from the reservoir Kličava (calculated for specimens with the body length 20—320 mm from mean in the Table 7)

HL	=	−0.20689	+	0.24000	BL
HD	=	−1.70247	+	0.18877	BL
HW	=	−1.64229	+	0.14644	BL
BD	=	−0.50189	+	0.26467	BL
PoD	=	−0.34955	+	0.12038	BL
PrD	=	−0.21382	+	0.07819	BL
ID	=	−0.93089	+	0.10962	BL
ED	=	+1.41642	+	0.03886	BL
PrdD	=	+0.18405	+	0.53243	BL
PodD	=	+3.22466	+	0 30969	BL
PvD	=	+2.79412	+	0.48538	BL
BDF	=	−0.93418	+	0.11205	BL
BAF	=	−1.88782	+	0.11672	BL
PF	=	−1.56995	+	0.20223	BL
CF	=	+1.58108	+	0.19851	BL
VF	=	−7.11661	+	0.20271	BL
LCP	=	+0.99826	+	0.17169	BL
DCP	=	−0.11583	+	0.13765	BL
RDF	=	+2.04627	+	0.18205	BL
RAF	=	+0.94026	+	0.16160	BL

BL — body length, HL — head length, HD — head depth, HW — head width, BD — body depth, PoD — postorbital distance, PrD — preorbital distance, ID — interorbital distance, ED — eye diameter, PrdD — predorsal distance, PodD — postdorsal distance, PvD — preventral distance, BDF — length of base of dorsal fin, BAF — length of the base of anal fin, PF — length of pectoral fin, CF — length of caudal fin, VF — length of ventral fin, LCP — length of caudal peduncle, DCP — depth of caudal peduncle, RDF — longest ray in dorsal fin, RAF — longest ray in anal fin)

were found, the mean being 7.96. 7 rays in the ventral fin were found in rivers San, Soła and Vistula, too.

7) Rays in the pectoral fin

The number of all rays in the pectoral fin in the examined sample was 13—18, the mean 15.35 (2 % of the specimens had 13 rays, 9 % had 14 rays, 29 % had 18 rays, 37 % had 16 rays, 21 % had 17 rays and 2 % had 18 rays in the pectoral fin). In my own material I have found the greatest variability concerning the *number of rays in* the pectoral fin/in the Vistula drainage ranges 15—18 were found, the mean 16.2.

8) Number of gill rakers

Specimens in my sample had 7—11 gill rakers on the outer side of the first gill arch and 12—13 on the inner side. On the outer side of the gill arch there are thickened gill rakers, dwarfed and ramified in some specimens. In literature I have found data about the variability agreeing with my results (e. g., in the Dunaj drainage 7—10 (the mean 9) and in the Vistula drainage 7—11 (the mean 9.1) gill rakers were found on the outer side of the first gill arch.

B) Plastic characters

Plastic characters depend probably on different water environment. But when comparing average values of plastic characters in my sample (originating from

Table 9. Plastic characters of the chub (*Leuciscus cephalus*) from the drainage of the river Labe see Ohva, 1963) and the river Niemen (see Žukov, 1958)

Character	own values	Labe	Niemen
In % of total length			
body length	76.0—86.8 (82.4)	—	—
In % of body length			
head length	19.5—27.5 (23.9)	22—27 (26.0)	21.9—26.9 (24.6)
head depth	14.5—19.5 (17.6)	—	—
head width	10.9—15.3 (13.5)	—	—
interorbital distance	8.1—11.6 (10.2)	—	—
preorbital distance	5.1—10.7 (7.7)	—	—
postorbital distance	9.4—13.4 (11.8)	—	—
eye diameter	3.7—7.4 (4.9)	—	—
body depth	24.1—27.6 (26.0)	22—25 (23.7)	21.4—27.3 (25.1)
predorsal distance	48.5—58.7 (53.4)	52—59 (54.6)	51.0—55.0 (53 6)
postdorsal distance	28.6—39.6 (33.3)	—	35 5—41.4 (38.7)
preventral distance	46.6—55.6 (50.6)	44—53 (49 9)	—
length of the caudal peduncle	12.7—22.1 (17 9)	15—20 (17.8)	20.5—24.4 (22.2)
depth of the caudal peduncle	10.1—18.6 (13.7)	—	11.5—14.1 (12.9)
length of the base of D	7.5—12.7 (10.5)	9—13 (11.3)	8.9—11.4 (10.3)
length of the base of A	7 4—12.6 (10.3)	8—13 (10.1)	8.6—12.1 (10.3)
depth of D	12.1—24.3 (19.8)	9—13 (11.3)	17,2—20.0 (18.6)
depth of A	12.6—21.2 (16.9)	8—13 (10.1)	14.2—16.0 (15.1)
length of P	16.0—21.5 (18.1)	15—20 (17.8)	17.5—20.0 (18.8)
length of V	13.5—18.9 (16.1)	12—17 (15.5)	14.5—17.5 (16.4)
length of C	14.6—29.3 (21.0)	17—22 (19.9)	—
In % of head length			
preorbital distance	26.1—38.9 (31.9)	30—34 (31.9)	30 2—34.5 (32.2)
eye diameter	16.3—28.5 (22.4)	16—21 (18.5)	16.0—24.3 (21.7)
interorbital distance	31.3—46.7 (38.8)	37—42 (39.3)	36.5—42.0 (39.0)
postorbital distance	40.6—57.2 (47.8)	47—56 (51 6)	44.0—52.0 (47.2)
head depth	62.3—86.3 (70.7)	62—69 (65.6)	64.0—72.0 (68.9)

In % of length of caudal peduncle			
its depth	59.9—89.3 (70.2)	46—69 (57.0)	—
length of P	92.3—127.5 (100.8)	—	—
length of V	69.7—100 0 (86.3)	—	—

stagnant water) with the data found in the specimens inhabiting rivers, I have found only very small differences (see Tab. 7,9—11). In my sample, lower mean of values was found in the following parameters : preorbital distance in % of body length was found as 7.7 (the Vistula drainage 8.1, the Tisa drainage 8.7); postdorsal distance in % of body length 33.3 (the Vistula drainage 37.1, the river Niemen 38.7); interorbital distance in % of head length 38.8 (the river Niemen 39.0, the Labe drainage 39.3, the Dunaj drainage 40.2, the Vistula drainage 40.7, the Tisa drainage 41.5); head length in % of the body length 23 9 (the Vistula drainage 24.5, the river Niemen 24.6, the Labe drainage 26.0, the Tisa drainage 26.7, the Dunaj drainage 26.8).

Higher mean of values was found in the following parameters in my sample: body depth in % of body length 26.0 (the Labe drainage 23.7, the Tisa drainage 23.9, the Dunaj drainage 24.3, the Vistula drainage 24.5, the river Niemen 25.1);

Table 10. The plastic characters of the chub (*Leuciscus cephalus*) from different localities (the drainage of the river Dunaj — see Oliva (1952 a, b), Libosvárský (1956))

Character	Bečva	Svratka	Morava
In % of body length			
head length	27—29(28.1)	23—26(25 5)	23—28
body depth	21—26(23.4)	23—27(25.1)	24—26
predorsal distance	52—58(54.8)	53—56(55.2)	—
preventral distance	48—56(51 0)	51—55(53.0)	—
length of caudal peduncle	21—25(22.5)	16—18(16 8)	—
length of the base of D	10—12(10.9)	10—12(10.9)	—
length of the base of A	8—11(9.5)	9—11(9.5)	—
length of longest rays of D	17—20 (18.4)	16—20 (17.9)	—
of A	14—16 (15.4)	13—17 (15.7)	—
length of P	18—20 (18.7)	16—19 (17.7)	—
length of V	15—16 (15.4)	14—19 (15.7)	—
length of C	21—24 (22.0)	—	—
In % of head length			
preorbital distance	—	26—36 (31.8)	—
eye diameter	—	14—23 (18.4)	16—19
interorbital distance	—	29—43 (40.2)	—
postorbital distance	—	47—55 (50.3)	—
head depth	—	69—75 (72.7)	63—74
In % of length of caudal peduncle			
its depth	—	77—86 (82.6)	57—70
length of P	—	61—78 (72.7)	—
length of ventral fin	—	63—87 (74.8)	—

Table 11. Plastic characters of the chub (*Leuciscus cephalus*) from different rivers (the drainage of the river Tisa see Dorko (1964), the drainage of the river Odra see Oliva (1953a))

Character	Ondava	Odra
In % of body length		
head length	24.1—28.3 (26.7)	27—28 (27.5)
head depth	18.4	—
interorbital distance	11.1	—
preorbital distance	8.7	—
postorbital distance	13.4	—
eye diameter	5.9	—
body depth	20.3—26.9 (23.9)	24—26 (25.0)
predorsal distance	50.2—59.8 (56.2)	54—57 (55.5)
preventral distance	49.7—54.1 (52.4)	50 (50.0)
length of the caudal peduncle	18.5—23.9 (21.8)	21—22 (21.5)
length of the base of D	8.9—12.5 (11.6)	11—12 (11.5)
length of the base of A	8.3—12.3 (10.1)	10—11 (10.5)
length of the longest ray of D	16.0—20.2 (19.5)	17—18 (17.5)
length of the longest ray of A	13.7—17.3 (16.6)	14 (14.0)
length of P	16.2—20.3 (18.9)	17—18 (17.5)
length of V	13.5—17.5 (15.8)	15 (15.0)
length of C	22.1	—
In % of head length		
preorbital distance	29.0—36.2 (32.5)	31—32 (31.5)
eye diameter	18.2—24.3 (22.0)	20—21 (20.5)
interorbital distance	38.9—43.3 (41.5)	36—38 (37.0)
postorbital distance	46.5—54.6 (50.2)	51—52 (51.5)
head depth	63.6—72.3 (69.1)	62—65 (63.5)
In % of length of caudal peduncle		
its depth	58.8	58 (58.0)

longest ray in the dorsal fin (= depth of the dorsal fin) in % of the body length 19.8 (the Vistula drainage 17.9 the Dunaj drainage 18.2, the river Niemen 18.6, the Tisa drainage 19.5); longest ray in the anal fin (depth of the anal fin) in % of the body length 16.9 (the river Niemen 15.1, the Vistula drainage 15.5, the Dunaj drainage 15.6, the Tisa drainage 16.6); longest ray in the pectoral fin in % of the body length 19.1 (the Labe drainage 17.8, the Dunaj drainage 18.2, the Vistula drainage 18.2, the river Niemen 18.8, the Tisa drainage 18.9).

Length of the head in % of the body depth is in the mean 93.5 (ranges 81.5—100.0) in my sample. This is the value of the nominal *Leuciscus cephalus cephalus* Linnaeus, 1758. In the river Ondava (the drainage of the river Tisa), Dorko (1969) found a population which seems to intergrate towards the subspecies *Leuciscus cephalus orientalis*, Nordmann, 1840. Dorko (l. c.) found that the head length (calculated in % of the body length) is longer (26.7) than the body depth(23.9). However Oliva (1952 a, 1963) in the drainage of the river Labe and in the river Bečva, Libosvárský (1956) in the river Svratka, Mahen (1930) in 4 specimens from rivers Jihlávka, Váh and Dunaj, Rolik 1962) and Klimczyk (1965) in the river San, also found a longer head length than the body depth in their materials (see Tab. 10—12). Therefore, this difference between both subspecies seems to be dubious. It is probable that subspecies *L. cephalus orientalis* is only one of the ecological varieties of the chub (see Rolik, 1962).

Table 12. Plastic characters of the chub (*Leuciscus cephalus*) from different rivers (the drainage of the river Vistula — see Rolik (1962), Klimczyk (1965) and Lewandowska-Jarzynowa (1969))

Character	San (Rolik, 1962	San (Klimczyk, 1965	Wisła	Soła	Tanew	Wirowa	Bukowa
In % of body length							
head length	23.2—28.3 (25.9)	25.5	24.2	25.5	23.4	23.4	23.0
head depth	— —	17.1	16.9	16.7	15.8	16.0	16.1
head width	3.1—16.2 (14.8)	—	—	—	12.4	12.6	12.0
interorbital distance	8.8—12.1 (10.6)	10.3	9.7	9.7	9.2	9.4	8.7
preorbital distance	—	8.4	8.1	7.9	—	—	—
postorbital distance	—	12.7	12.2	12.2	12.5	11.9	10.9
eye diameter	—	5.1	4.6	5.2	4.8	4.9	5.0
body depth	20.3—25.1 (22.9)	24.2	26.3	25.5	23.6	24.7	24.1
predorsal distance	51.8—58.1 (54.9)	—	54.9	—	54.3	52.8	51.8
postdorsal distance	34.6—39.4 (37.2)	36.8	37.4	36.8	38.8	36.8	36.3
preventral distance	49.2—53.5 (51.2)	—	—	—	—	—	—
length of caudal peduncle	18.5—23.7 (21.7)	—	—	—	—	—	—
length of P	17.2—20.1 (18.6)	17.9	17.3	18.4	18.6	18.1	18.4
length of V	13.5—16.9 (15.4)	14.8	14.4	15.4	15.4	15.4	16.2
length of C	18.8—23.7 (21.4)	20.7	20.8	21.5	—	—	—
length of the base of D	9.6—12.1 (10.7)	9.8	10.5	9.9	10.7	11.4	10.8
length of the base of A	8.1—12.3 (10.2)	8.9	9.6	8.7	10.4	11.3	10.0
length of the longest ray of D	15.7—20.4 (18.0)	18.4	16.5	18.7	17.5	17.5	18.5
length of the longest ray of A	11.9—16.5 (14.5)	16.0	14.3	16.8	15.2	15.1	16.4
In % of head length							
preorbital distance	30.8—37.8 (34.1)	—	—	—	—	—	—
eye diameter	16.3—27.8 (22.5)	—	—	—	—	—	—
interorbital distance	37.1—44.6 (40.7)	—	—	—	—	—	—
postorbital distance	47.7—53.9 (50.4)	—	—	—	—	—	—
head depth	61.2—73.5 (67.7)	—	—	—	—	—	—
In % of length of caudal peduncle							
its depth	53.2—65.6 (59.3)	—	—	—	—	—	—
In % of head length							
its width	53.1—61.3 (57.1)	—	—	—	—	—	—

I observed higher values in the length of pectoral fin (100.8) and ventral fin (86.3) in % of the length of caudal peduncle in comparison with Libosvárský's (1956) data concerning chub from the river Svratka (72.7 and 74.8).

The changes of plastic characters in relation with the size of specimens are summarized in Table 7. In Table 8 equations are given of different plastic characters in relation with the body length. All examined relationships given in Table are linear. It is interesting that Nardi (1980) found that the relatio-relationship between head length and total length in the chub (*Leuciscus cephalus cabeda*) is parabolic. From Table 7 it is evident that averages in individual length groups coincide, except the eye diameter, postdorsal distance, preventral distance, length of caudal peduncle and length of caudal fin (all calculated as % of the body length), where the values slightly decrease with the size. In the values of the head width, postdorsal distance, length of the base of the dorsal fin, length of the base of the anal fin and length of the pectoral fin (all calculated in % of the body length), a slight increase with the size is observable. Concerning the length of the longest ray in the dorsal fin in % of the body length and in the length of ventral fin in % of the body length, in smaller specimens (less than 120 mm of the body length) the average is higher than in bigger ones. Changes of plastic characters in relation with the size of the chub were mentioned by Oliva (1953) and Libosvárský (1956). Decreasing values of plastic characters related to the increasing size of the specimens were found by Libosvárský (1956) in the eye diameter, length of the caudal fin and the head length (only in females). Libosvársky (l. c.) found an increase of values of the interorbital distance and postorbital distance in % of the body length in relation with the increasing of body length.

In comparison with Libosvárský (l. c.) I have not found any positive correlation between the body length and the body depth. The problem of the sex was not studied in my material. Some authors (Oliva 1953; Libosvárský 1956; Klimczyk 1965; Lewandowska-Jarzynowa 1969) found very small differences of plastic and meristic characters between both sexes in the chub.

SUMMARY

The plastic and meristic characters of the chub from the water reservoir Klíčava were compared with 6 European drainages (Labe, Odra, Dunaj, Tisa, Vistula, Niemen).

Comparing my sample originating from stagnant water with data from different European rivers I found a higher mean of values of the body depth, the longest ray in the dorsal fin, the longest ray in the anal fin, length of the pectoral fin (all calculated in % of body length). I found a lower mean of values in preorbital distance, postorbital distance, head length (in % of the body length) and interorbital distance in % of the head length (see Table 9—11). Relationships between different plastic characters and the body length were found as linear (see Table 8). Only in my own material I found 2 non-branched rays in the anal fin (in 99 % of examined specimens). The chub from the reservoir Klíčava can be classified as belonging to the nominal subspecies *Leuciscus cephalus* (Linnaeus, 1758).

Morphometric characters of the nominal subspecies of the chub based on 2197 specimens from examined drainages are as follows (arithmetic means):

number of rays in the dorsal fin 2 9/8 1, number of rays in the anal fin 2 9/8 4 number of all rays in the ventral fin 8 2, number of rays in the pectoral fin 16 0 number of scales in the lateral line 44 7, number of scales above the lateral line 7 3, below the lateral line 3 3, number of gill rakers 9 1 In $^0/_0$ of the body length head length 25 3 head depth 16 8, head width 13 1, interorbital distance 9 9 preorbital distance 8 2, postorbital distance 12 2, eye diameter 5 1, body depth 24 5 predorsal distance 54 4 postdorsal distance 36 9, preventral distance 51 2, length of the caudal peduncle 20 3 length of the base of the dorsal fin 10 8 length of the base of the anal fin 9 9, length of the longest ray in the dorsal fin 17 7, length of the longest ray in the anal fin 15 2, length of the pectoral fin 18 3, length of the ventral fin 15 5, length of the caudal fin 21 2. In $^0/_0$ of the head length preorbital distance 32 3, eye diameter 20 9 interorbital distance 39 5, postorbital distance 49 9 and head depth 68 3

It is probable that subspecies *Leuciscus cephalus orientalis* is only one of the ecological varieties of the nominal subspecies

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FURTHER NOTES ON ALONA KARELICA (CLADOCERA, CHYDORIDAE) FROM EAST SLOVAKIA

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Abstract. *Alona karelica* (Stenroos, 1897) from Czechoslovakia is described. Female is characterized by blunt rostrum and typical postabdomen with minute basal spine on terminal claw. It was found that males as described in literature are typical for immature individuals. Different characters of coocurring species from this region are also included.

INTRODUCTION

The species *Alona karelica* belongs to rare Cladocera in holarctic region (Hrbáček et al., 1978). The occurrence in Malaysia (Idris, 1983) is evidently not valid.

This species was originaly described from Karelia (Stenroos, 1897) and later found in South Finland, Jamal Peninsula (Smirnov, 1971), Germany (Flössner, 1963, 1972, Herbst, 1962, 1974), in the region of the upper River Volga (Flössner, 1972), Hungary — Sarospatak, inundation of the River Bodrog (Gulyas, 1974) and East Slovakia (Hudec, 1980). Localities from Alps (Hrbáček, et al., 1978) and from Kaukasus (Behning, 1941) were not confirmed.

Descriptions and pictures in literature differ from the another. Differences are clearly evident in Flössner (1972), Manuilova (1964) and Herbst (1962). Populations from East Slovakia are similar to Flössner's (1972) description and drawing.

MATERIAL EXAMINED

Strážne (7098), May 26, 1973, draining channel with slow water, lgt. J. Brtek; two parthenogenetic females mounted in Canada balsam, stained with Coemassic Brillant Blau R 600 (MERCK), deposited in Nat. Hist. Museum in Bojnice (Czechoslovakia) No. VII/a — 3344 511.

Zatín — Boľ (7597), September 22. 1981, swamp near the rooad, lgt. Hudec; eight parthenogenetic, two ephippial females and two males mounted in Canada balsam, stained with lignin pink and chlorazol black. One slide in Dr. Kořínek's coll. and remaining material in author's collection,

Veľké Kapušany — Leles (7598), August 9. 1983, old isolated oxbow of the River Latorica, lgt. Hudec; five parthenogenetic, three ephippial females and three males.

Five individuals were dissected for a detail study of head pores and thoracic limbs.

DESCRIPTION

Size: fifteen parthenogenetic females in length from 0.36 — 0.51 mm and height from 0.25—0.32 mm. Five ephippial females in length 0.45 — 0.47 mm,

height 0.30 – 0.33 mm. Five males in length 0.32 – 0.36 mm and height 0.16 – 0.18 mm/mature males).

Female (Figs. 1 – 3, 6 – 8)

Head (Fig. 1, 2, 6): long rostrum with blunt tip (lateral aspect) as shown in Herbst (1962), Flössner (1972) and Smirnov (1971). From dorsal aspect rostrum broadly vaulted or nearly even. Ocellus smaller than compound eye. Three median pores connected and located in the posterior bent of head shield. Interpore distance 0.024 mm in both sexes. Lateral pores not seen. The postpore distance 1.2 – 2 of interpore distance (for explanation see Frey, 1980).

Labrum: anterior edge conspicuosly rounded with vaulted tip, posterior edge near even.

Antennules (Fig. 7): spindlike, stout not reaching the tip of rostrum. Sensory setae (7) short, reaching over rostral margin. The lateral seta approximately in median position.

Antennae: setae 0–0–3/0–1–3, spines 1–0–1/0–0–1.

Shell (Fig. 1, 2): general shape bean-like, dorsal margin strongly convex, ventral margin slightly concave. Surface with numerous tubercules. Anterior part of ventral rim with short hairs, posterior part with longer hairs.

Ephippium (Fig. 1): primitive, dark brown coloured, with one egg.

Postabdomen (Fig. 3): slightly elongated. Dorsal and ventral margin parallel. Postanal angle relatively sharp, in some specimens with one spicula. Dorsal row of 4 – 5 teeth with fine bristles on proximal dish. Teeth decreasing in size proximally followed by 2 – 4 small and thin teeth on humps grouped with fine hairs or spicules in clucters. Groups of braches of fine setae present over dorsal margin. The distalmost seta is the longest. The terminal claw elongated. Basal spine minute, equal to the basal width of the claw.

First trunk limb (Fig. 8): corm with five fan-like rows of setae. Outer distal lobe with long seta. Inner distal lobe with two setae. Posterior part of 1-st lobe with one relatively short seta, 2-nd lobe with three setae and ultimate lobe with three setae.

Male (Fig. 4, 5, 9)

Similar to the female in general morphology with some differences in the shape of head, postabdomen and structure of 1-st trunk limb.

Head – rostrum less curved, more wide than in female. Shell more elongated. Postabdomen – distalmost corner not prominent, broadly rounded; dorsal margin with 3 – 4 groups of short hairs, the distalmost hair within group being the longest. Distal third of terminal claw „S" shaped. Basal spine reduced to one half or one third of basal width of the terminal claw. Spermaduct orifices over terminal claws.

Male postabdomen as depicted in all cited literature is typical of immature males as well as the copulatory hooks (J-shaped).

1-st trunk limb (Fig. 9): corm with dense fine setulation on the anterior margin. The copulatory hook U-shaped, with blunt tip and 2 – 3 small humps on convex part. Copulatory brush opposite to the tip of copulatory hook. Outer distal lobe with one long seta and inner distal lobe with two setae. Posterior part similar to that of female.

BIOLOGY

Alona karelica Stenroos is living on muddy bottom with plant remains. It often has been found among roots of plants in association Hydrocharition, less in Lemnion minoris (H o l u b et al., 1967) ,pH 5.6 — 6.7, alcalinity 2.0 — 2.8 mval, acidity 0.10 — 0.65 mval, temperature of water up to 27.2 °C, which is not in agreement with H e e r (1917) according to M a n u i l o v a (1964).

In our samples *Alona karelica* was mostly coocurred with following species of Cladocera: *Ceriodaphnia reticulata, Alona reticulata, A. costata, Pleuroxus aduncus* and *Chydorus sphaericus* s. str. Rarely with *Simocephalus vetulus, S. exspinosus exspinosus, Oxyurella tenuicaudis, Alona* cf. *intermedia* and *Pleuroxus laevis*.

REMARKS

Species can be mistaken with *Alona costata* Sars, which is more frequent; however, both species differ in many aspects.

Alona karelica (female) is characterized by the broad tip of rostrum. Also head pores (lateral pores) are different. Surface of valves is never with striped reticulation in *Alona karelica* (usually granulated). The shape of postabdomen is related to that of *Alona costata*, but denticulation on dorsal margin is different in both species.

A c k n o w l e d g e m e n t

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The figures will be found at the end of this issue.

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DIE COLEOPTERENFAUNA DES RAPSFELDS

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A b s t r a c t A total catch of 4,409 adult Coleoptera was obtained from a rape -field in western Bohemia by sweeping, beating and pitfall trapping. The found fauna is briefly characterized and the data on its diversity, trophic relations and seasonal dynamics are given. The major species are typical of agricultural habitats. The species associated trophically with the cultivated plant markedly prevailed in the herb stratum, whilst common euryecious species of agrobioceonoses were predominant on the soil surface. The high relative moisture in the undergrowth is favourable to a great species diversity of the soil-surface families Carabidae and Staphylinidae. The trapping season has been divided into three successive periods (aspects). The prevernal aspect is characterized by the dominance of carrnivorous predators of the soil surface, the vernal aspect by the dominance of species feeding on rape, the estival aspect by the highest species diversity. The ecological analysis agrees with the general idea about a highly productive monoculture preserved in the climax state by additional energy, whose species diversity is reduced by the farming methods.

EINLEITUNG

Die künstlichen Ökosysteme sind ihrer Natur nach instabil. Dafür sind sie durch die Konkurenz, Krankheiten, Parasiten, Prädatoren und durch die anderen negativen Beziehungen leicht verletzbar. Die Agrosysteme stellen überdies die zeitigen Sukcessionstadien dar ,mit ihren saisonen Veränderungen der trophischen Struktur, die sich in der Änderung der Gemeinschaft, besonders der Produzenten und der primärem Konsumenten, abspiegelt. Im Klimaxstadium sind diese Systeme durch die Erganzung der Energie gehalten. Ihrer Untersuchung wurde schon seit langem beträchtliche Aufmerksamkeit gewidmet (siehe z. B. T i s c h l e r, 1965). Es ist je mehr überraschend, dass eine Untersuchung der hochproduktiven Raps-Monokultur, deren Diversität stark durch die agrotechnischen Eingriffe herabgesetzt wird, bisher nicht durchgeführt worden ist. Unsere Studie begranzt sich nur auf die Untersuchung der Käfer, die jedoch einen dominanten Teil der Biozönose der Rapskultur darstellen und durch die bedeutendsten Schadlinge vertreten sind.

Die Landwirtschaft realisierte in unseren Bedingungen in der letzten Zeit eine ausgepragte Spezialisierung und Konzentration der bestellten Kulturen Diese Grossproduktionsform der Bodenbeaarbeitung beeinflusst tief das Ökosystem. Die agrotechnischen und agrobiologischen Massnahmen bedeuten fur gewisse Arten immer grössere und mehr ausgeglichene Nahrungsquellen, die einen direkten Grund für ihre Übermehrung vorstellen. Unsere Arbeit stellt einen Versuch über die Auswertung der ökologischen Beziehungen der untersuchten Kaferarten eben in diesen Beziehungen dar.

MATERIAL UND METHODE

Untersuchungsgebiet

Das Untersuchungsgebiet liegt in Westbohmen bei der Gemeinde Litice, etwa 5 km südwestlich von Plzeň (Pilsen). Das untersuchte Feld, auf lehmig-sandigem Boden, mit der Ausdehnung von 43,6 ha, lag in der Seehöhe von 355 m. Sein kurzester Ostrand war durch einen Grasrain begrenzt. Von übrigen Seiten war es von anderen landwirtschaftlichen Kulturen umschlossen.

Auf dem studierten Grundstuck wurden folgende Unkrautarten festgestellt: *Stellaria media* (L.) Vill. ssp. *media*+++, *Tripleurospermum maritimum* (L.) Koch.+++, *Convolvulus arvensis* L +++, *Myosotis arvensis* (L.) Hill.+++, *Viola arvensis* Murr.+++, *Elytrigia repens* (L.) Desv.+++, *Polygonum aviculare* L.+++, *Anagallis arvensis* L.++, *Raphanus raphanistrum* L.+, *Chenopodium album* L.+, *Urtica dioica* (L.) Scop.+, *Medicago sativa* L.+, *Taraxacum officinale* Web +, *Vicia villosa* Roth. ssp. *vilosa*+. Die Haufigkeit des Vorkommens ist durch die Zahl der Kreuzchen bezeichnet. Die Mehrzahl der Unkräuter kam auf den Rändern der Versuchsfläche vor.

Das Feld wurde im August 1974 mit Winterraps der Abart Třebíčská bestellt Es wurde chemisch am 14 8. 1974 mit Lass (gegen *Apera spicaventi* und zweikeimblattrige Unkrauter) und am 30. 4. 1975 mit Thiodan 35 EC (gegen *Meligethes aeneus*) gepflegt. Am 21. 7. 75 wurde die Dessikation mit dem Praparat Reglone ausgeubt. Funf Tage nach diesem Eingriff wurde die Rapskultur abgeerntet.

Wetterverlauf

Die durchschnittlichen Tagestemperaturen und die Summe der Niederschlage im Vergleich mit den langfristigen Mittelwerten sind für die Versuchsperiode den Abbildungen 1 und 2 zu entnehmen. Aus dem Vergleich folgt, dass der Marz wärmer und feuchter, der April wärmer und sehr trocken, der Mai uber den Durchschnitt regnerisch, der Juni wärmer und mehr regnerisch und der Juli sehr trocken waren.

Fangmethoden

Zum Fang der Käfer in der Krautschicht haben wir zwei kvantitative relative Methoden, das Abstreifen und das Abklopfen der Vegetation benutzt,

Das Abstreifen haben wir vom 20. 4. bis 21. 7. 1975 durchgeführt (20. 4., 30. 4., 2. 5., 15. 5., 1. 6., 21. 6., 24. 6., 12. 7., 14. 7., 21. 7.). Weil es sich um einen homogenen Be-

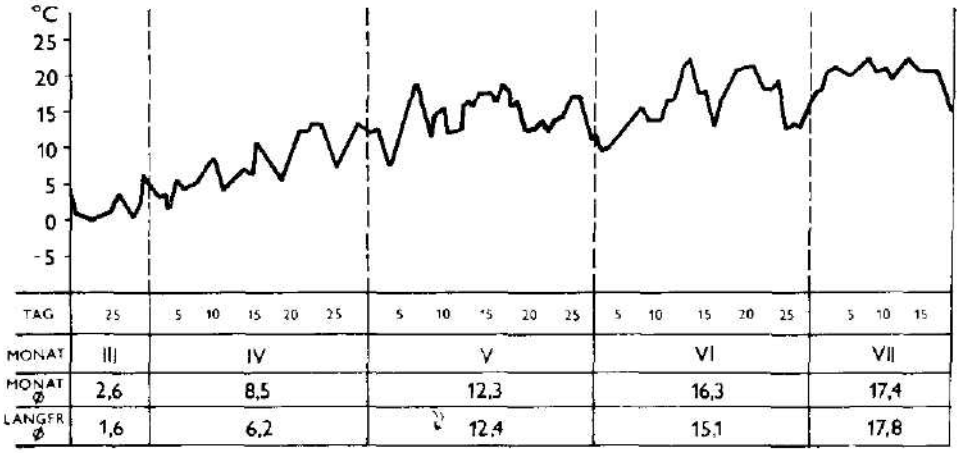
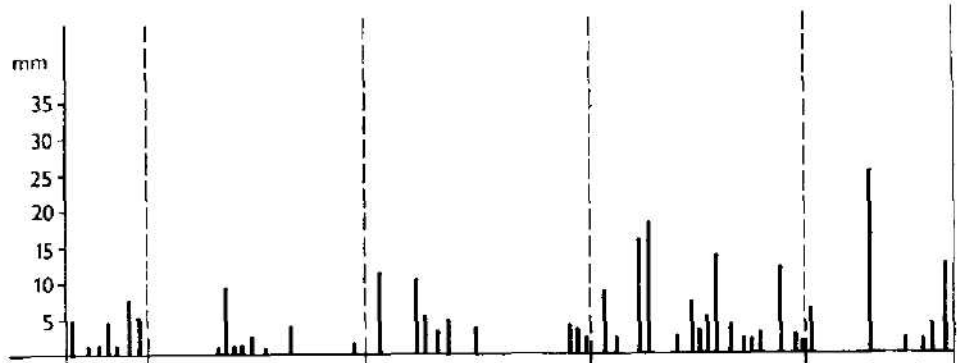


Abb. 1. Verlauf der durchschnittlichen Tagestemperaturen in der Versuchsperiode 1975 im Vergleich mit den langfristigen Mittelwerten. Angaben aus der meteorologischen Station Litice

wuchs handelte, haben wir nur je 50 Streifen am Rand und innen im Feld (wenigstens 50 m vom Rand) gemacht. Wir haben uns bemüht den gleichen Radius des Abstreifens einzuhalten (bei einem Streifnetzschlag durchschnittlich ca. 1,5 m). Es wurde das übliche Streifnetz vom Kreisdurchschnitt 35 cm benutzt. Das Abstreifen der Vegetation wurde zwischen 12 und 16 Uhr realisiert.

Das Abklopfen der einzelnen Pflanzen in die Kunststoffsäckchen nach Dirlbek (1974) vom Rand in der Richtung zur Mitte des Felds wurde für die Untersuchung der Dispersion von *Meligethes aeneus* zur Zeit seines Maximalauftretens vom 20. 4.



TAG	25	5 10 15 20 25	5 10 15 20 25	5 10 15 20 25	5 10 15
MONAT	III	IV	V	VI	VII
SUMME	36,1	21,2	73,4	89,9	38.3
LANGFR. Ø	29,1	44,1	58,6	67,1	64.1

Abb. 2. Übersicht über die Regenfälle in der Versuchsperiode 1975 im Vergleich mit den langfristigen Mittelwerten. Angaben aus der meteorologischen Station Litice.

bis 1. 6. 75 in folgenden Tagen durchgeführt: 29. 4., 30. 4., 2. 5., 15. 5., 18. 5. und 1. 6. Es wurde die durchschnittliche Anzahl für eine Pflanze, von 20 zufälligerweise ausgewählten, gerechnet.

Zum Fang der epigäisch aktiven Käfer wurde die Fallenfangmethode mit 4 % Formalin als Fangflüssigkeit benutzt (Leerzeit ca. 14 Tage, 1 l Glässer, Blechdach, Öffnungsweite: d = 9,5 cm). 10 Fallen wurden in der Entfernung 30 m vom Rand in einer Linie in der Richtung Mitte des Felds in gegenseitigen Abständen ca. 20 m angeordnet. Die Gründung am 22. 3. 75, das Leeren am 19. 4., 2. 5., 15. 5., 1. 6., 21. 6., 12. 7., 21. 7. 75.

Bewertung der Ergebnisse

Als Ausdruck der gesamten Artendiversität wurde der Shannon & Weaver — Index (1949) benutzt: $H_s = \sum_{i=1}^{s} \frac{n_i}{N} \log_2 \frac{n_i}{N}$

wobei i = i^{te} Art, n_i = Individuenanzahl jeder Art, N = Gesamtanzahl der Individuen, s = Gesamtanzahl der Arten.

Weil die Artendiversität vom Artenreichtum und der Artengleichförmigkeit abhängig ist, bedeutet die Charakteristik der Gemeinschaft durch ihre Indexe die Verbindung beider Faktoren. Eine Gemeinschaft mit weniger gleichmässig vertretenen Arten kann den gleichen Diversität-Index aufweisen wie eine Gemeinschaft mit vielen ungleich vertretenen Arten (z. B. Pielou, 1975). Es ist also wichting die beiden Bestandtteile der Diversität festzustellen.

Tabelle 1. Familien und Artenliste

Taxon	Gesamtanzahl	Dominanz %
Carabidae	**1092**	**24,76**
Carabus granulatus L.	3	0,07
Notiophilus pusillus G. R. Waterh.	1	0,02
Loricera pilicornis (F.)	61	1,38
Clivina collaris (Herbst)	2	0,05
Clivina fossor (L.)	14	0,32
Bembidion lampros (Herbst)	55	1,25
B. obtusum Serv.	27	0,61
B. quadrimaculatum (L.)	10	0,23
Trechus quadristriatus (Schrank)	3	0,07
T. secalis (Payk.)	1	0,02
Pseudoophonus rufipes (De Geer)	58	1,32
Harpalus aeneus (F.)	198	4,49
H. atratus Latr.	1	0,02
Amara plebeja (Gyll.)	7	0,16
A. aenea (De Geer)	9	0,20
A. communis (Panz.)	17	0,39
A. familiaris (Duft.)	14	0,32
A. lunicollis Schiodte	1	0,02
A. ovata (F.)	7	0,16
A. similata (Gyll.)	50	1,13
A. tibialis (Payk.)	1	0,02
A. apricaria (Payk.)	1	0,02
Poecilus cupreus (L.)	50	1,13
Pterostichus melanarius (Illig.)	212	4,81
P. vernalis (Panz.)	2	0,05
Calathus fuscipes (Gozee)	29	0,66
C. melanocephalus (L.)	9	0,20
Agonum dorsale (Pont.)	247	5,60
Brachinus explodens Duft.	2	0,05
Histeridae	**3**	**0,07**
Margarinotus purpurascens (Herbst)	3	0,07
Silphidae	**37**	**0,84**
Nicrophorus vespillo (L.)	36	0,82
Blitophaga opaca (L.)	1	0,02
Catopidae	**16**	**0,36**
Sciodrepoides watsoni (Spence)	13	0,29
Catops nigrita Er.	3	0,07
Liodidae	**2**	**0,05**
Colenis immunda (Sturm)	1	0,02
Agathidium atrum (Payk.)	1	0,02
Clambidae	**1**	**0,02**
Clambus armadillo (De Geer)	1	0,02
Staphylinidae	**423**	**9,63**
Eusphalerum abdominale (Grav.)	2	0,05
Oxytelus insecatus Grav.	2	0,05
O. rugosus (Grav.)	8	0,18
O. tetracarinatus (Block)	9	0,20
Paederus litoralis Grav.	2	0,05
Lathrobium fulvipenne (Grav.)	12	0,27
L. geminum Kr.	5	0,11
L. longulum Grav.	3	0,07
Gyrohypnus angustatus (Steph.)	1	0,02
G. fracticornis (Müll.)	29	0,66

Xantholinus longiventris Herr	6	0,14
X. tricolor (F.)	4	0,09
Philonthus agilis (Grav.)	2	0,05
P. concinus (Grav.)	10	0,23
P. decorus (Grav.)	8	0,18
P. fuscipennis (Mannh.)	51	1,16
P. laminatus (Creutz.)	2	0,05
P. splendens (F.)	1	0,02
P. varius (Gyll.)	59	1,34
Philonthus sp.	1	0,02
Bryocharis analis (Payk.)	2	0,05
Tachyporus abdominalis (F.)	3	0,07
T. chrysomelinus (L.)	3	0,07
T. hypnorum (L.)	13	0,29
T. pusillus Grav.	3	0,07
T. solutus Er.	3	0,07
Tachyporus sp.	3	0,07
Tachinus laticollis (Gtav.)	3	0,07
T. rufipes (De Geer)	8	0,18
Atheta sp. div.	144	3,27
Drusilla canaliculata (F.)	2	0,05
Oxypoda opaca (Grav.)	1	0,02
Oxypoda sp.	1	0,02
Aleochara bilineata Gall.	2	0,05
A. bipustulata (L.)	14	0,32
A. curtula (Goeze)	1	0,02
Cantharidae	**25**	**0,56**
Cantharis fulvicolis F.	4	0,09
C. fusca L.	1	0,02
C. lateralis L.	4	0,09
Cantharis sp.	3	0,07
Metacantharis discoidea (Ahr.)	5	0,11
M. haemorrhoidalis (F.)	8	0,18
Melyridae	**2**	**0,05**
Malachius bipustulatus (L.)	2	0,05
Elateridae	**26**	**0,59**
Drasterius bimaculatus (Rossi)	2	0,05
Cryptohypnus quadripustulatus (F.)	5	0,11
Prosternon tesselatum (L.)	2	0,05
Selotosomus latus (F.)	6	0,14
Agriotes lineatus (L.)	1	0,02
A. obscurus (L.)	1	0,02
A. sputator (L.)	9	0,20
Nitidulidae	**2526**	**57,29**
Meligethes aeneus (F.)	2525	57,27
M. viridescens (F.)	1	0,02
Cryptophagidae	**12**	**0,27**
Parameçosoma melanocephala (Herbst)	12	0,27
Phalacridae	**7**	**0,16**
Olibrus aeneus (F.)	5	0,11
O. bimaculatus Küst.	2	0,05
Lathridiidae	**1**	**0,02**
Lathridius angusticollis Gyll.	1	0,02
Coccinellidae	**18**	**0,41**
Tytthaspis sedecimpunctata (L.)	10	0,23
Coccinella septempunctata L.	5	0,11
Adalia bipunctata (L.)	1	0,02
Anatis ocellata (L.)	2	0,05
Scarabaeidae	**18**	**0,40**
Onthophagus ovatus (L.)	16	0,36

O. verticicornis (Laich.)	1	0,02
Aphodius distinctus (Müll.)	1	0,02
Cerambycidae	1	0,02
Vadonia livida F.	1	0,02
Chrysomelidae	112	2,54
Phyllotreta atra (F.)	1	0,02
P. nemorum L.	9	0,20
P. nigripes (F.)	2	0,05
P. undulata Kutsch.	32	0,73
Psylliodes chrysocephala (L.)	68	1,54
Curculionidae	87	1,96
Apion laevigatum (Payk.)	1	0,02
Sitona libialis (Herbst)	1	0,02
Ceutorrhynchus assimilis (Payk.)	23	0,52
C. contractus (Marsh.)	1	0,02
C. erysimi (F.)	1	0,02
C. pleurostigma (Marsh.)	5	0,11
C. quadridens (Panz.)	49	1,11
C. sulcicollis (Payk.)	6	0,14

Als Ausdruck des Artenreichtums (der Artenbuntheit) verwenden wir den Menhinick-Index (1964), der vom Studium der Insekten der Krautschicht durch Abstreifen-Methode abgeleitet wurde

$$d = \frac{s}{\sqrt{N}},$$

wobei s = die Artenanzahl, N = die Individuenanzahl.

Als Mass für die Artengleichförmigkeit (Äquität, Gleichmässigkeit) benutzen wir den Index nach Pielou (1966)

$$e = \frac{H}{\log_2 s},$$

wo H = Shannon-Index und s = die Gesamtartenzahl.

Im gegenteiligen Verhältnis zur Äquität steht die Dominanz. Bei der Benützung des Simpson-Indexes (1949)

$$c = \sum_{i=1}^{s} \left(\frac{n_i}{N}\right)^2,$$

c = die Wahrscheinlichkeit, dass 2 zufällig und unabhängig ausgewählte Individuen einer Art gehören, n_i = die Anzahl jeder Art, N = die Individuenzahl.

Als Ausdruck der perzentuellen Dominanz (der relativen Häufigkeit) und damit der Bedeutung der Taxa im Ökosystem haben wir die dreistufige Skala verwendet: dominant $=> 5\,\%$, influent $= 2$—$4{,}99\,\%$, rezedent $= 0{,}1$ — $1{,}99\,\%$.

Bei der Bewertung der trophischen Beziehungen der Käfer im Rapsfeld haben wir der Auffassung nach Szelenyi (1955) gefolgt. Die phytophagen Konsumenten werden als Corrumpentes, die Prädatoren und Parasiten als Obstantes, die Saprophagen, Koprophagen und Necrophagen als Intercalares und die Bestäuber als Sustines bezeichnet.

Bei der Bewertung der Aspektfolge haben wir die Auffassung von Odum (1977) gebraucht, der die folgenden sechs Perioden unterscheidet: hibernale, prevernale, vernale, aestivale, serotinale und autumnale.

ERGEBNISSE

Allgemeine Artenliste

Durch alle Methoden wurden insgesamt 4409 Käferindividuen erbeutet, die 19 Familien und mindestens 114 Arten gehören. In der Tabelle 1 sind die abso-

Tabelle 2. Carabidae, Auftreten der dominanten und influenten Arten

Art	IV. 19.	V. 2.	V. 15.	VI. 1.	VI. 21.	VII. 12.	VII. 21.	Summe	Dom. %
Agonum dorsale	—	4	21	18	83	76	49	247	22.6
Pterostichus melanarius	—	—	1	—	20	97	85	212	19,4
Harpalus aeneus	7	7	5	5	44	52	78	198	18,1
Loricera pilicornis	—	10	7	3	33	8	3	61	5,6
Pseudoophonus rufipes	—	—	3	1	13	17	24	58	5,3
Bembidion lampros	6	4	10	9	4	9	11	55	5,0
Poecilus cupreus	—	1	4	—	18	25	7	50	4,6
Amara similata	—	—	8	—	25	13	12	50	4,6
Calathus fuscipes	—	—	—	—	2	18	9	29	2,7
Bembidion obtusum	16	1	1	7	1	1	—	27	2,5

luten Individuenzahlen und die perzentuelle Dominanz aller gefundenen Arten und Familien angegeben.

Charakteristik der gefundenen Käferfauna

Carabidae

1092 Individuen von 29 Arten wurden ausschliesslich durch den Fallenfang erworben. In der Tabelle 2 ist das Verzeichnis von 10 dominanten und influenten Arten zu finden. Die Carabiden machten sich ausdrucksvoll an der epigäischen Käferfauna geltend (64 % der Gesamtindividuenzahl). Die Mehrzahl der Arten ist exklusiv karnivor. Ökologisch gehören Carabidae in die Gruppe der Obstantes als Prädatoren verschiedener Insekten und anderer Kleintiere. Ökonomisch stellen die Laufkäfer den nützlichsten Teil der Käfersynusie des verfolgten Biotops dar.

Histeridae

Rezedente Käferfamilie, die durch die einzige Art, *Margarinotus purpurascens* repräsentiert wird. Nur 3 Individuen (IV., V.) wurden in den Fallen gefunden. Die Art lebt häufig unter faulenden organischen Überresten, wo sie die Kleintiere jagt.

Silphidae

Es wurden nur zwei Arten festgestellt. Der nekrophage *Nicrophorus vespillo* kam fast gleichmässig während der ganzen Versuchsperiode vor, die phytophage *Blitophaga opaca* wurde nur im einzigen Exemplar gefunden; beide Arten nur durch Fallenfang.

Catopidae

Auch die zwei Catopidenarten, der häufigere *Sciodrepoides watsoni* und der seltenere *Catops nigrita*, wurden nur in Fallen festgestellt. Beide sind nekrophag und kommen besonders auf kleinen Kadavern vor.

Liodidae

Nur zwei Arten wurden gefunden, beide in den Fallen: *Colenis immunda*

Tabelle 3. Staphylinidae, Auftreten der dominanten und influenten Arten

Art	IV.	V.		VI.		VII.		Summe	Dom. %
	19.	2.	15.	1.	21.	12.	21.		
Atheta sp.	42	1	1	30	24	76	40	144	34,0
Philonthus varius	1	—	—	9	22	17	10	59	14,0
Philonthus fuscipennis	17	—	—	—	15	10	9	51	12,0
Gyrophypnus fracticornis	1	1	—	16	2	3	6	29	6,9
Aleochara bipustulata	2	—	—	1	2	3	6	14	3,3
Tachyporus hypnorum	—	1	—	2	3	4	3	13	3,1
Lathrobium fulvipenne	2	—	—	1	—	4	5	12	2,8
Philontus concinus	—	—	—	—	1	—	9	10	2,4
Oxytelus tetracarinatus	2	—	—	3	—	—	4	9	2,1

(1 Ex., VII.) und *Agathidium atrum* (1 Ex., VI.). Diese winzige Käfer, deren Biologie sehr ungenügend bekannt ist, sind wahrscheinlich phytophag.

Clambidae

In einer Falle wurde nur *Clambus armadillo* (1 Ex., V.) festgestellt. Er lebt im faulenden Material pflanzlicher Herkunft.

Staphylinidae

Die Kurzflügler beteiligten sich mit 25 % auf der Gesamtbeute des Fallenfangs (422 Individuen) und mit den Laufkäfern bildeten sie fast 90 % der Gesamtindividuenzahl der epigäischen Käferfauna. Ihre Artenzahl ist mindestens mit 36 angegeben, dabei die Gattung *Atheta* nicht bis zur Art bestimmt wurde. Nur ein Exemplar der florikolen Art *Eusphalerum abdominale* wurde abgesteift. Die Tabelle 3 zeigt die Übersicht der dominanten und influenten epigäischen Arten. Die meisten gefundenen Arten gehören zu den Karnivoren, nur ein kleiner Teil sind Saprophage (z. B. einige *Atheta*-Arten) und die einzige Art *(Eusphalerum abdominale)* ist phytophag. Die überwiegende Karnivorie der gefundenen Staphyliniden zeigt bei der Häufigkeit ihrer Vertreter die Bedeutung der Familie in der künstlichen Biozönose als nützlicher Prädatoren.

Cantharidae

Die Arten der Weichkäfer wurden meist durch Abstreifen erworben. In den Fallen wurden nur 3 Individuen von *Cantharis lateralis* (VI., VII.) gefunden. Am häufigsten kamen die beiden gemeinen *Metacantharis*-Arten, *M. disoidea* und *M. haemorrhoidalis* vor, beide ab Ende Juni. Ab Ende Mai, mit dem Maximum im Juni, vertraten die Familie 4 Arten der Gattung *Cantharis*. Die Weichkäfer sind vorwiegend Karnivore, die zu den üblichen Bewohnern der Feldkulturen gehören und den nützlichen Anteil der Insektenfauna darstellen.

Melyridae

Anfang Juli wurden 2 *Malachius bipustulatus* Exemplare auf den Rapspflanzen gefunden. Was die Nahrungsbiologie und die Bedeutung in der Biozönose betrifft, ähneln die *Malachius*-Arten den Weichkäfern.

Elateridae

Sieben Arten der Schnellkäfer wurden durch 26 Individuen vertreten, meistens (5 Arten mit 24 Ex.) in den Erdfallen. Die Mehrzahl der Arten ist sowohl

Tabelle 4. Verhältnis zwischen der Anzahl der adulten *M. aeneus* auf eine Pflanze am Rand und im Inneren des Felds (Abklopfen)

Phänophasis	Datum	Mittelzahl der Käfer auf eine Pflanze Rand	Innere
Blühenanfang	28.4.	6,6	2,2
Blühenanfang	29.4.	10,5	6,4
Blühenanfang	30.4.	10,4	5,1
Blühenanfang	2.5.	8,5	6,4
Blühenverlauf	15.5.	23,6	10,1
Blühenverlauf	18.5.	27,5	4,7
Blühenende	1.6.	10,7	0,3

als Larve, als auch als Imago phytophag. Die 2 häufigsten Arten *Agriotes sputator* und *Selatosomus latus* gelten als übliche Feldschädlinge. Zum Maximalauftreten der Elateriden kam im Juni vor.

Nitidulidae

Auf der Versuchsfläche wurden 2 Arten festgestellt. Ausser 15 Individuen von *Meligethes aeneus*, die zufälligerweise in die Fallen gelangten, wurden alle übrigen Glanzkäfer auf den Pflanzen getroffen.

Nur in einem Exemplar wurde *Meligethes viridescens* erbeutet. Er kommt seltener mit *M. aeneus* auch auf den Rapsfeldern vor und weist auch ähnliche Lebensweise auf.

M. aeneus bildete 57,27 % aller gefundenen Käfer-Individuen und ökologisch stellte er die wichtigste Art der Käfer-Synusie dar. Die Käfer fliegen die Kultur in der Zeit an, wenn die Pflanzen beginnen die Blütenknospen zu bilden. *M. aeneus* ist im Imaginalstadium der bedeutendste Rapsschädling. Es wurde seit langem erkannt, dass auf den Feldrändern sein Vorkommen grundsätzlich grösser ist als im Zentralteil der Kultur. Das Verhältnis zwischen der Käferan-

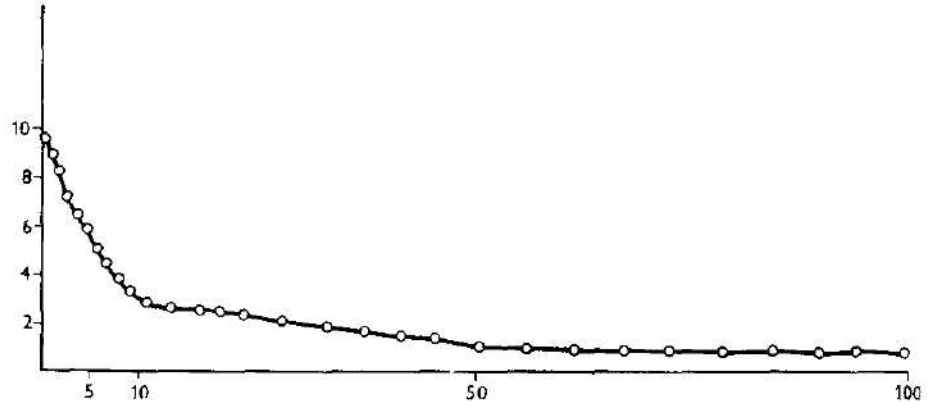


Abb. 3. Die Vorkommensintensität von *M. aeneus* vom Rand zur Mitte der Rapskultur (Abklopfen-Methode). x—Achse, die Entfernung von Rand in m; y—Achse, Mittelzahl der Käfer auf eine Pflanze.

zahl auf eine Pflanze am Rand und in der Mitte der Kultur (mindestens 50 m vom Rand), durch die Abklopfen-Methode festgestellt, zeigt die Tab. 4. Die Abb. 3 demonstriert den Vergleich der Auftretensintensität im Gradient Rand--Mitte. Im Verlauf der ganzen Versuchsperiode wurde die Anzahl der Käfer innen im Feld bedeutend niedriger als am Rand: die Mittelzahl auf eine Pflanze inmitten der Kultur betrug 35,3 % des Werts auf den Rändern. In der Rich-

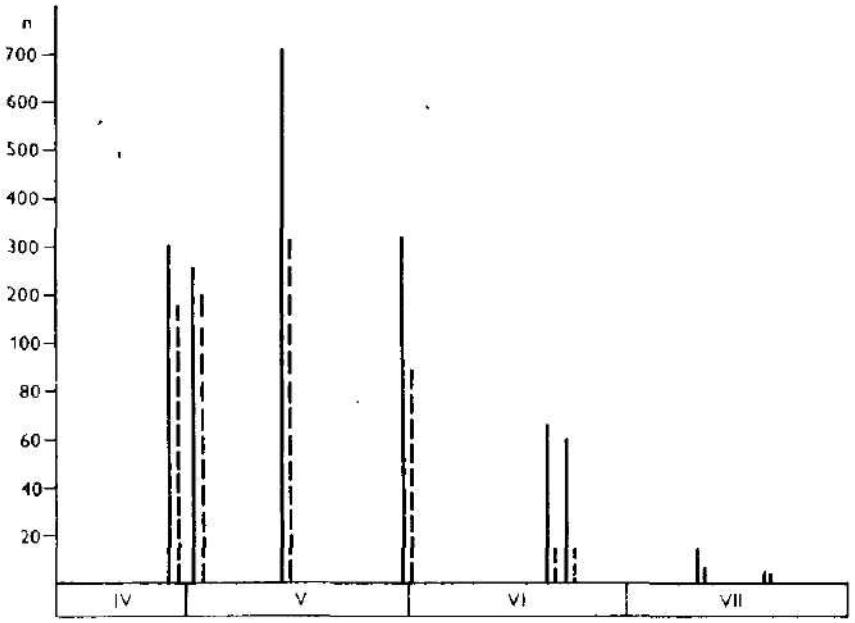


Abb. 4. Die Vorkommensintensität von *M. aeneus* (Abstreifen-Methode) ———— Ränder, — — — — — Feldinneres).

tung zur Feldmitte sank die Auftretensintensität ausdrucksvoll bis ca. zur Entfernung 100 m vom Feldrand. In der Entfernung ca. 50 m vom Rand kam es zum Flächenausgleich des Vorkommens. Die Abnahme der Käferzahl auf eine Pflanze Ende April und Anfang Mai (Tab. 4) wurde durch die Verwendung der Insektizide verursacht.

Durch die Abstreifen-Methode stellten wir die ersten Exemplare schon am 20. April fest, wann die Temperatur in den Mittagstuden 16 °C erreichte. Der Massenanflug begann um 30. IV., also zur Zeit des bedeutenden Aufstiegs der Tagestemperaturen bei minimalen Niederschlägen (Abb. 1, 2). Zur Periode des Blütenendes (1. Juni) beobachteten wir grosse Menge Larven, die sich auf den spät blütenden Pflanzen häufen. Die Auftretenintensität der Imagines begann in der zweiten Mai-Hälfte zu sinken. Die Käfer waren jedoch vereinzelt bis zum Ende der Versuchsperiode zu finden (Abb. 4). Auf der Abbildung 4 ist auch die Verwendung der Insektizide Ende April gut erkennbar, wann der Aufstieg der *M. aeneus* Population zeitweilig aufgehalten wurde.

Tabelle 5. Das Vorkommen der Halticinae (Fallenfang)

Art	IV.	V.		VI.		VII.		Summe	Dom. %
	19.	2.	15.	1.	21.	12.	21.		
Psylliodes chrysocephala	3	1	–	5	–	2	2	12	28,5
Phyllotreta undulata	–	–	–	2	1	19	2	24	57,1
Phyllotreta nemorum	–	–	–	–	–	2	2	4	9,6
Phyllotreta nigripes	–	–	–	1	–	–	–	1	2,4
Phyllotreta atra	–	–	–	–	–	1	–	1	2,4

Cryptophagidae

Es wurde nur die Art *Paramecosoma melanocephala* durch Fallenfang festgestellt. Zwölf gefundene Individuen kamen unregelmässig in der ganzen Versuchsperiode vor.

Phalacridae

Diese Familie wurde durch 2 Arten repräsentiert. *Olibrus bimaculatus* wurde im Juni (1 Ex. in der Falle) und Juli (1 Ex. durch Abstreifen) gefunden, *Olibrus aeneus* stellten wir in 5 Individuen durch Abstreifen im Juni fest. Die letzte Art kam besonders in den Blüten von *Tripleurospermum maritimum* vor. Alle Arten der Familie gehören zu den florikolen Käfern, die sich in den Pflanzen entwickeln. Auf dem Versuchsfeld wurden sie mit Asteraceae verbunden.

Lathridiidae

Nur ein Exemplar von *Lathridium angusticollis* wurde im Juli in einer Falle gefunden. Die Art ernährt sich wahrscheinlich an pflanzlichen Überresten.

Coccinellidae

Es wurden 4 Arten in 18 Individuen festgestellt. Durch Fallenfang wurde nur die häufigste Art *Tyttaspis sedecimpunctata* erbeutet (10 Ex. V.—1, VI.—5, VII.—4). Von den übrigen, durch Abstreifen erworbenen Arten, wurde *Coccinella septempunctata* die wichtigste, obwohl alle gefundenen Marienkäfer sowohl im Larval- als auch im Imaginalstadium zu den Prädatoren der Blattläuse gehören.

Scarabaeidae

Alle 3 gefundene Arten wurden in den Fallen entdeckt; alle sind koprophag. Der häufigste *Ontophagus ovatus* kam in der ganzen Versuchsperiode vor. Man zählt die Art zu den gemeinen Besuchern der Exkrementen, faulender Vegetabilien und Nester der Kleinsäuger. Auch die übrigen 2 Arten, die nur in einem Exemplar festgestellt wurden, findet man oft in den Feldkulturen.

Cerambycidae

Anfang Juli gelangte von den umgebenden Biotopen ein Exemplar von *Vadonia livida* in das durch Abstreifen gewonnene Material.

Tabelle 6. Das Vorkommen der Halticinae (Abstreifen)

Art	IV.		V.			VI.			VII.		Summe	%
	20.	30.	2.	15.	1.	21.	24.	12.	14.	21.		
Psylliodes chrysocephala	—	—	—	—	—	4	10	20	10	12	56	81,1
Phyllotreta undulata	—	—	—	—	—	3	1	2	2	—	8	11,6
Phyllotreta nemorum	—	—	—	—	—	—	1	2	2	—	5	5,7
Phyllotreta nigripes	—	—	—	—	—	1	—	—	—	—	1	1,4

Tabelle 7. Artendiversität der dominanten und influenten Familien und der ganzen Ordnung Coleoptera

Gruppe	%	H	c	d	e
Nitidulidae	57,3	0,005	0,999	0,398	0,005
Carabidae	24,8	3,420	0,136	0,878	0,704
Staphylinidae	9,6	3,589	0,161	1,750	0,694
Chrysomelidae	2,5	1,410	0,457	0,472	0,607
Coleoptera	100,0	3,139	0,338	1,717	0,459

H = gesamte Artendiversität nach Shannon, Weaver, c = Dominanz nach Simpson, d = = Artenreichtum nach Menhinick, e = Gleichmässigkeit (Äquität) nach Pielou

Chrysomelidae

Die Familie wurde nur durch 5 Arten der Unterfamilie Halticinae vertreten, die sowohl durch Fallenfang (38 %, Tab. 5), als auch durch Abstreifen (62 %, Tab. 6) erbeutet wurden. Die häufigste Art stellte *Psylliodes chrysocephalus* dar (60,7 %), durch 4 *Phyllotreta* Arten gefolgt: *P. undulata* (28,6 %), *P. nemorum* (8,0 %), *P. nigripes* (1,8 %) und *P. atra* (0,9 %). Alle Arten sind Oligophage auf den Kreuzblütlern (Brassicaceae) und mit der Ausnahme von *P. nemorum* gehören sie zu den wichtigsten Rapsschädlingen. Sie sind univoltin mit der Imagoüberwinterung. Das Schlüpfen der neuen Generation verläuft im Juli und August, was mit dem Maximalauftreten der Halticinae auf der Versuchsfläche zusammenhängt.

Curculionidae

Die Rüsselkäfer wurden in 8 Arten, besonders durch das Abstreifen (90 %), festgestellt. Ausser den nur in einem Exemplar gefundenen *Apion laevigatum* (VII.) und *Sitona tibialis* (V.) handelte es sich um Vertreter der Gattung *Ceutorrhynchus*. Es wurden 6 Arten bestimmt: *C. quadridens* (57,6 %), *C. assimilis* (27,1 %), *C. sulcicollis* (7,0 %), *C. pleurostigma* (5,9 %), *C. erysimi* und *C. contractus* (je 1,2 %). Alle dominanten Vertreter dieser Gattung sind durch ihre Entwicklung mit Raps verbunden. Die häufigste Art *C. quadridens*, die durch die ganze Versuchsperiode festgestellt wurde, entwickelt sich als Larve im Rapsstengel. *C. assimilis* lebt als Larve in den Früchten und *C. pleurostigma* und *C. sulcicollis* entwickeln sich im Larvalstadium in den Wurzeln.

Diversität

Die Werte der Artendiversität der dominanten und influenten Familien sowie der ganzen Ordnung Coleoptera zeigt die Tabelle 7. Die gesamte Artendiversität *H* ist bei den Familien der Krautschicht (Nitidulidae, Chrysomelidae) viel niedriger als bei den Familien der Erdoberfläche (Carabidae, Staphylinidae). Bei den letzten ist *H* sogar höher als die gesamte Artendiversität aller Käferarten im Biotop. Der hohe Wert der Artendiversität ist durch die niedrige Dominanz *c* begleitet und umgekehrt. Auch der Artenreichtum *d* ist erheblich höher für die Familien des Epigaions. Eine ausdrucksvolle Ungleichmässigkeit in der Vertretung einzelner Arten (*e*) macht sich bei den Nitiduliden geltend. Die Änderungen in der Artendiversität der Käfer der Krautschicht im Verlauf

der Versuchsperiode sind aus der Abb. 5 erkennbar. Die gesamte Artendiversität *H*, der Artenreichtum *d* und die Gleichmässigkeit *e* sind niedrig vom Anfang der Blütenknospenbildung bis zum Blütenende, also ab Ende April bis Anfang Juni, wann in der Krautschicht *M. aeneus* überwiegt. Das Sinken der Auftretensintensität dieser Art ist mit dem Sinken der Dominanz c und mit dem Aufstieg der übrigen Kennziffern der Artendiversität begleitet. Der Aufstieg ist auch durch die Gesamterhöhung der Artenzahl in der Krautschicht verursacht, wo ab der zweiten Maihälfte ausser den Käferarten, die an Raps

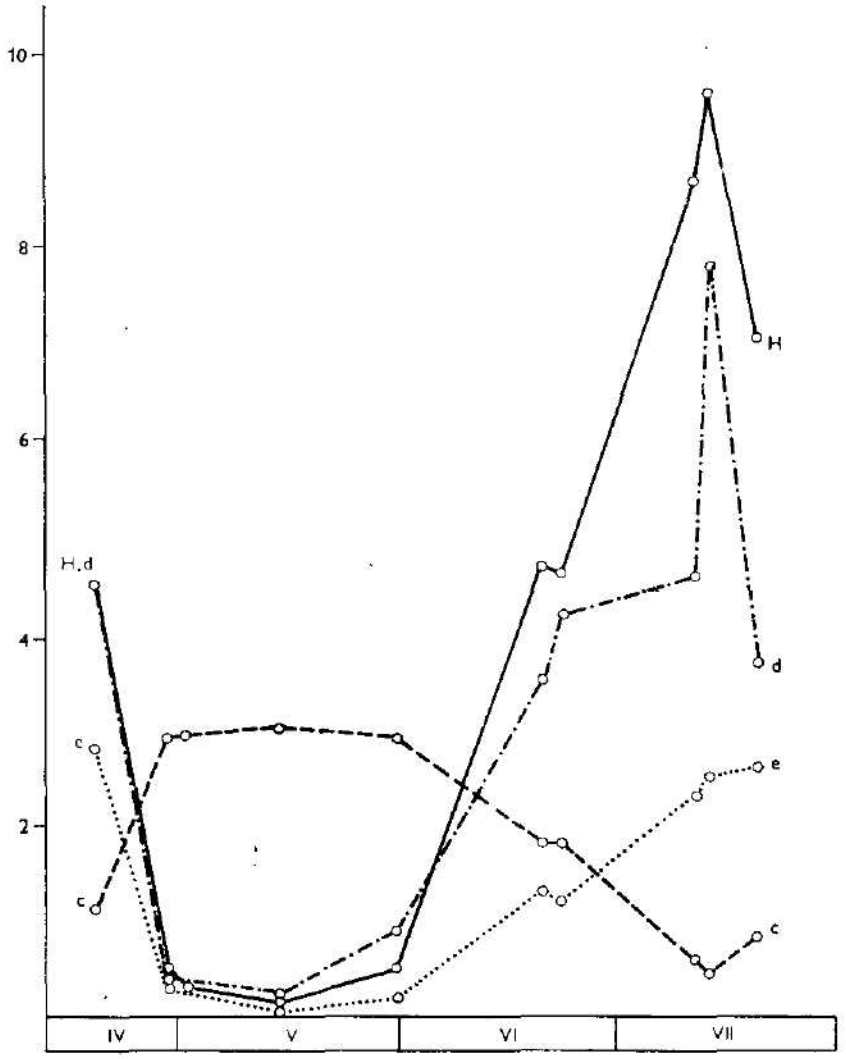


Abb. 5. Die Änderungen in den Werten der Artendiversität der Käfer in der Krautschicht (Abstreifen-Methode), H — gesamte Artendiversität nach Shannon, c — Dominanz nach Simpson, d — Artenreichtum nach Menhinick, e — Gleichmässigkeit (Äquität) nach Pielou.

als Nahrung gebunden sind, auch Karnivore und an Unkräuter gebundene phytophage Arten, erscheinen. Eine ausführlichere Analyse der Nahrungsstruktur ist im folgenden Kapitel zu finden.

Tropische Beziehungen

Aus der gesamten Anzahl der 4409 erbeuteten Käferindividuen von mehr als 114 Arten gehörten ca. 63 % der Individuen und 25 % der Arten in die Gruppe der phytophagen Konsumenten also den Corrumpenten, 35 % der Individuen und 67 % der Arten in die Gruppe der karnivoren Konsumenten also den Obstanten und nur 2 % der Individuen und 8 % der Arten zur Gruppe Intercalares.

Innerhalb der unzahlreichen Gruppe Intercalares überwiegen die Koprophagen und Necrophagen der Familien Silphidae, Catopidae und Scarabaeidae. Als saprotrophe Arten machen sich die Käfer der Familien Clambidae, Lathridiidae und Cryptophagidae geltend, die jedoch nur mit 3 Arten und 14 Individuen vertreten wurden.

Die Gruppe Obstantes zählt 76 Arten, während die Corrumpentes, trotz ihrer hohen Individuenzahl, nur 29 Arten. Im Rahmen der Gruppe Obstantes sind die Carabidae und Staphylinidae die bedeutendsten; zur Gruppe gehören noch die Vertreter der Familien Histeridae, Cantharidae, Melyridae und Coccinellidae. Für den perzentuellen Anteil der Individuen sind die Laufkäfer massgebend.

Auf der Zusammensetzung der Phytophagen der Gruppe Corrumpentes machen sich bedeutendst die Nitiduliden, im höheren Mass dann noch die Familien Chrysomelidae und Curculionidae geltend, die Arten umfassen, die an Raps gebunden sind. In kleinerem Mass beteiligen sich noch die Familien Elateridae, Phalacridae, Staphylinidae, Liodidae, Silphidae und Cerambycidae.

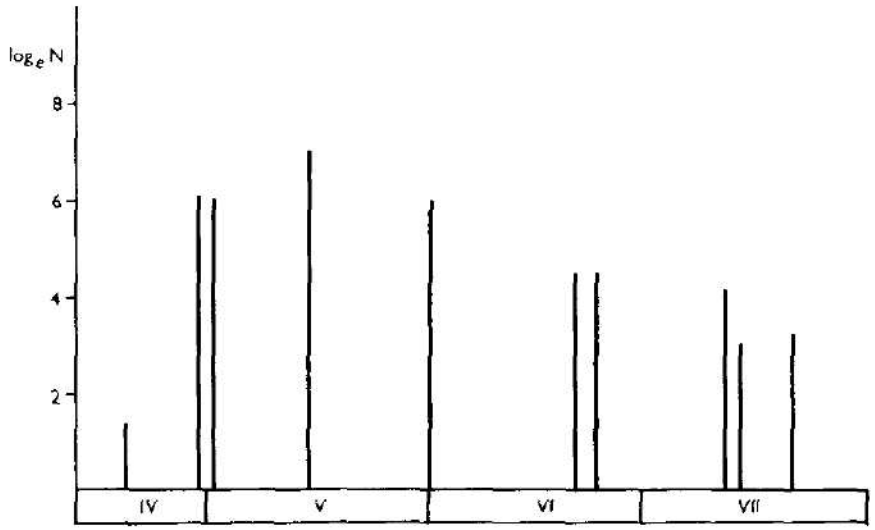


Abb 6. Das Auftreten der Individuen der phytophagen Käferarten (in logaritmischen Massstab — $\log_e N$) in der Krautschicht (Abstreifen-Methode).

Von diesen Familien können folgende Arten als trophisch und durch ihre Entwicklung an Raps gebunden gelten: *Meligethes aeneus, M. viridescens, Psylliodes chrysocephala, Phyllotreta undulata, P. nemorum, P. nigripes, P. atra, Ceutorrhynchus contractus, C. quadridens, C. assimilis, C. pleurostigma, C. sulcicollis* und die Larven der Schnellkäfer. An Unkräuter wurden besonders *Blitophaga opaca, Eusphalerum abdominale, Olibrus bimaculatus* und *O. aeneus* gebunden.

Bis Anfang Mai wurden in den Proben aus der Krautschicht nur phytophage Arten gefunden, die sich mit Raps ernähren. Mitte Mai und Anfang Juni wur-

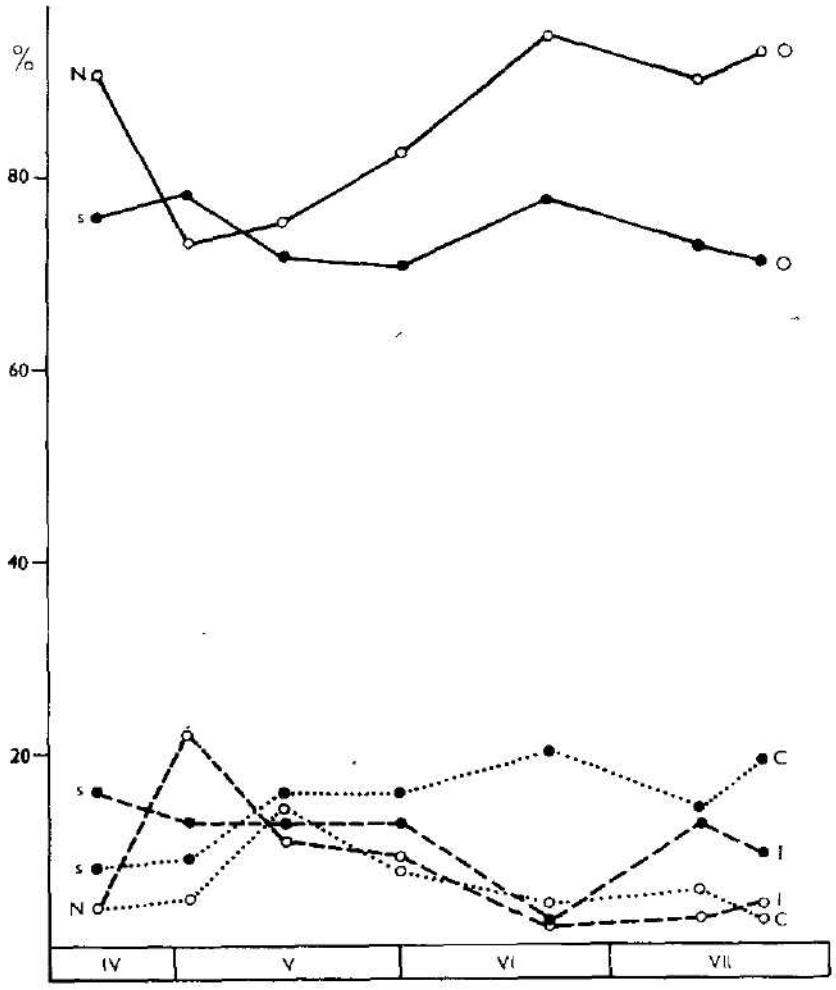


Abb. 7. Perzentuelle Vetretung einzelner trophischer Gruppen auf der Bodenoberfläche. ———— Obstantes, — — — — — Intercalares, ... Corrumpentes, s — Artenanzahl (volle Kreise), N — Individuenanzahl (leere Kreise). Angaben aus den Fallen.

den die ersten Karnivoren und die an Unkräuter gebundenen Phytophagen verzeichnet; beide Grupen kamen erst ab Ende Juni häufiger vor. Die Obstantes zahlen ca. 30 % der Arten und 11 % der Individuen. Der grundsätzliche Teil der Kafersynusie gehört jedoch immer den Corrumpenten (Abb. 6).

Die perzentuelle Vertretung der tropischen Gruppen auf der Bodenoberfläche, nach den Angaben der Fallenfangmethode, gibt die Abb. 7. In der ganzen Versuchsperiode überwiegt sowohl in der Artenanzahl als auch in der Anzahl der Individuen die karnivore Gruppe Obstantes. Die Carabiden und Staphylinden, die Hauptdarsteller der Gruppe, erreichen ihr Maximalauftreten im Juni und Juli.

Aspektfolge

Auf Grund der Werte der Artendiversität und der trophischen Struktur der studierten Insektenordnung haben wir ihr Auftreten im Verlauf der Saison in drei Perioden aufgeteilt, die durch die Entwicklung der Vegetation der Rapskultur leicht zu erkennen sind. Als prevernale Periode bezeichnen wir den Zeitraum der niedrigen Vegetation ab zeitigem Frühling bis zur Bildung der Rapsblütenknospen. Zur vernalen Periode zählen wir die einzelnen Raps-Phanophasen (Anfang, Verlauf, Ende der Blütezeit). Den Zeitraum nach dem Verblühen bis zur Ernte bezeichnen wir als die aestivale Periode.

Der prevernale Aspekt ist durch die relativ hohe Artendiversität und Dominanz besonders der karnivoren Arten des Epigaions, die in mehreren Feldbiotopen vorkommen, charakterisiert. Es gehören zu ihnen vorwiegend die Staphylinidae (die Arten der Gattungen *Atheta, Oxytelus, Philonthus fuscipes* u. a.), die feuchtigkeitsliebenden Arten der Laufkäfer *(Loricera pilicornis, Bembidion quadrimaculatum, B. obtusum, Trechus secalis)*, die überwinterten Individuen einiger weiteren Arten der Familie *(Notiophilus pusillus, Trechus quadristriatus, Bembidion lampros, Harpalus aeneus, Agonum dorsale* u. a.). Weiter die Vetreter der Familien Silphidae, Catopidae, Cryptophagidae und Scarabaeidae. Im prevernalen Aspekt machen sich auch die überwinterten Imagines der Unterfamilie Halticinae und der Familie Elateridae geltend. In der Krautschicht erscheinen sporadisch die ersten Vertreter der Gattungen *Ceutorrhynchus* und *Meligethes.*

Der vernale Aspekt ist völlig durch das Auftreten der Kafer, die trophisch an Raps gebunden sind charakterisiert. Massgebend ist das Vorkommen von *Meligethes aeneus* zusammen mit allen Arten, die sich auf und im Raps entwickeln. Die Artendiversitat sinkt ausdruckvoll, in der Krautschicht überwiegen die Phytophagen der Gruppe Corrumpentes.

Der aestivale Aspekt ist durch den Ruckgang von *M. aeneus* bestimmt. Zusammen mit anderen trophisch an Raps gebundenen Arten kommt *M. aeneus* bis zur Mahd vor, in der Krautschicht beginnen sich jedoch bedeutender auch die phytophagen Arten der Unkräuter und besonders die Karnivoren geltend machen. Auf der Bodenoberflache steigt die Dominanz der trophischen Gruppe Obstantes an, ihr Maximalauftreten erwiesen die Individuen der Carabidae und Staphylinidae. Das Artenspektrum wächst erheblich, es erscheint die Mehrzahl aller Vertreter weniger häufig vorkommender Familien wie z. B. Liodiden, Melyriden, Phalacriden und Lathridiiden. Die Artendiversität erreicht ihr Maximum.

DISKUSSION

Artenzusammensetzung

Im Ganzen entspricht die gefundene Käferfauna den übrigen Feldbiotopen; es wurde die Mehrzahl der charakteristischen Arten der Agrobiozönosen festgestellt.

Unter den Arten der Bodenoberfläche überwiegen im Laufe der ganzen Versuchsperiode die feuchtigkeitsliebenden Käfer. Das Mikroklima wurde speziell nicht gemessen, jedoch der dichte und gut geschlossene Rapsbewuchs, der der Evaporation vorbeugt, verursachte, dass die unteren Pflanzenblätter immer nass waren, auch am Mittag beim vollen Sonnenschein. Diese Tatsache ermöglichte das Auftreten stark hygrophiler Arten, die besonders an Ufern von Gewässern vorkommen. Von den Carabiden z. B. *Loricera pilicornis*, die im Rahmen der Familie als dominante Art auftritt, *Bembidion quadrimaculatum*, beide *Clivina*-Arten u. a. Von den Staphyliniden z. B. *Tachyporus abdominalis* und andere Arten.

Das gesamte Vorkommen der Familie Carabidae steht kvalitativ im Einklang mit den Angaben aus den anderen Feldbiotopen in der Tschechoslowakei (z. B. Skuhravý, Novak, 1957; Skuhravý, 1959; Skuhravý, Novák, Starý, 1959; Novak. B., 1968; Obrtel, 1968; Petruška, 1971. 1972, 1974). Aus diesen Literaturangaben geht hervor, dass in verschiedenen Feldbiotopen 19 bis 33 Laufkäferarten gefunden wurden, in der Abhängigkeit vom Bestandsschluss und von der Art der Bewirtschaftung. In mehreren Agrobiotopen befanden sich 7 Arten als dominant oder influent: *Pterostichus melanarius*, *Bembidion lampros*, *Pseudoophonus rufipes*, *Poecilus cupreus*, *Calathus fuscipes*, *Agonum dorsale* und *Harpalus aeneus*. Alle treten als dominant oder influent unter den 29 gefundenen Arten auch im Rapsfeld auf. Der Einklang im Auftreten der charakteristischen Feldlaufkäfer in verschiedenen Feldbiotope geht aus der Tatsache hervor, dass die Käfer nicht trophisch an die gepflanzte Kulturpflanze gebunden sind. Ihr Vorkommen ist besonders vom Mikroklima des Habitats und natürlich vom Nahrungsangebot beeinflusst. In der Rapskultur kamen uberdies haufig *L. pilicornis*, *B. obtusum* und *Amara similata* vor. Das seltene Vorkommen der Gattung *Carabus* wurde ohne Zweifel durch die intensiven agrotechnischen Eingriffe, besonders durch Einfluss der Insektizide verursacht.

Die Artendiversitat der Familie Staphylinidae wurde grösser festgestellt als in manchen Agrobiotopen in der Tschechoslowakei angegeben worden war. Z. B. Skuhravý, Novák, Starý (1959) geben vom Kleefeld nur 19 Arten, Doskočil und Hůrka (1962) von der Wiese 32 Arten und Skuhravý und Novák (1957) vom Kartoffelfeld sogar nur 11 Arten an. Nur Obrtel (1968) stellte auf einem Luzernefeld in Südmähren 40 Arten fest. Die angegebenen Autoren geben als die häufigsten Kurzflügler *Drusilla canaliculata*, *Tachyporus hypnorum*, *T. chrysomelinus*, *T. solutus*, *Atheta* sp. div., *Philonthus fuscipennis*, *P. varius*, *Oxytelus insecatus*, *Lathrobium fulvipenne* und *Xantholinus tricolor* an. Alle angegebenen Arten kamen auch mehr oder weniger haufig im Rapsfeld vor. Wir haben eine höhere Anzahl sowohl der Arten als auch der Individuen, als die Mehrzahl der Autoren in anderen Agrozönosen angeben festgestellt. Der Grund liegt wahrscheinlich im feuchteren Mikroklima des Rapsfelds, das den meisten Vertretern der Familie konveniert. Aus der faunistischen Hinsicht ist das Vorkommen seltener Art *Bryocharis analis* interessant.

Die Vertreter der weiteren Käferfamilien, mit der Ausnahme von Nitidulidae, Chrysomelidae und Curculionidae, stellen auch meistens die Arten dar, die nicht an das Rapsfeld fest gebunden wurden, sondern welche häufig auch in anderen Feldbiotopen vorkommen. Im Vergleich mit anderen Feldkulturen ist nicht nur die Übereinstimmung im Vorkommen der Familien, sondern bei den häufiger vertretenen Gruppen auch in der Anwesenheit der Arten (Histeridae, Silphidae, Cantharidae, Coccinellidae) gut erkenntlich.

Die Artenbuntheit der Familie Chrysomelidae ist niedriger als in anderen Feldbiotopen (Kleefeld 12, Kartoffelfeld 9 Arten). Der Grund liegt in der Tatsache, dass im Rapsfeld die Nährpflanze für alle Arten der Raps, dagegen in anderen Feldkulturen besonders die Unkräuter darstellen. Das gilt mehr oder weniger auch für die Familie Curculionidae.

Die Familie Nitidulidae macht sich ausdrucksvollst auf der auffälligen Dominanz der trophisch an den Raps gebunden Arten geltend. Die Konzentration von *M. aeneus* in den Randteilen des Feldes entspricht den Ergebnissen von Dirlbek (1974). Die Entwicklung der Larven dauert 20 bis 30 Tage. Die Käfer schlüpfen aus den Puppen im Boden nach 10—11 Tagen (Miller, 1956). Die Käfer der neuen Generation wurden also wahrscheinlich nicht mehr angetroffen.

Als Rapsschädlinge kommen aus anderen Familien die Larven der Schnellkäfer (Elateridae) in Betrachtung. Die Mehrheit der gefundenen Individuen gehörte den typischen Feldarten. Weil die meisten Imagines die Abend- bzw. Nachtaktivität aufweisen, wurden sie nur minimal durch Abstreifen festgestellt.

Von den bedeutenden Prädatoren der Krautschicht ist die niedrige Anzahl der Marienkäfer im Einklang mit den Beobachtungen verschiedener Autoren aus Feld- und Wiesenbiotopen.

Die erkannte Artenzusammensetzung entspricht der allgemeinen Vorstellung über das Artenspektrum der hochproduktiven Monokultur: 1) eine ausdrucksvolle Dominanz der Arten, die trophisch an das gepflanzte Produkt in der Weidekette gebunden sind, 2) das Auftreten der euryöken epigäischen Arten mancher Feldbiotope, 3) der Rückgang der Arten, die empfindlich gegen die agrochemischen Eingriffe sind.

Ökologische Faktoren

Der Versuch um die Einreihung der Arten in einzelne trophische Gruppen ist immer nicht ganz eindeutig, besonders bei den Gruppen Intercalares und Obstantes. So z. B. die Kurzflügler der Unterfamilien Aleocharinae, Tachyporinae und Oxytelinae sind Räuber oder sie ernähren sich mit abgestorbenen Pflanzenteilen und überhaupt mit verschiedenem faulendem organischem Material. Damit stellen sie eine Übergangsgruppe zwischen Intercalares und Obstantes dar. Als Saprophyte geben wir die Käfer der Familien Clambidae, Lathridiidae und Cryptophagidae an. Biologie mehrerer Arten ist jedoch bisher ungenügend bekannt und man behauptet nur, dass einen beträchtlichen Anteil ihrer Nahrung die abgestorbenen Reste der Pflanzenkörper darstellen. Aus der vierten Szelenyischen Gruppe Sustines (1955) würde als gelegentlicher Abstreifer *Meligethes aeneus* in Frage kommen. Trotz häufigem Vorkommen ist seine Bedeutung für die Befruchtung der Rapspflanzen nicht massgebend (Miller, 1956).

Was die Aspektfolge betrifft, kommt es in einigen Jahren besonders in der prevernalen Periode zu beträchtlichen Verschiebungen im Auftreten einiger Arten oder Artengruppen. Das gilt vorwiegend für die weniger häufig vorkommenden Arten (Skuhravý, Novák, 1957; Doskočil, Hůrka, 1962).

Bei der Bewertung der Artendiversität verwenden wir als Mass der Äquität den Index nach Pielou (1966). Weil wir jedoch die gesamte Artenanzahl s im Biotop zuverlässig nicht kennen, ist der Gebrauch des Indexes auch nicht ganz genau. Ein präziserer Massstab existiert aber unter diesen Umständen nicht (Pielou, 1975). Zum auffälligen Aufstieg der Artendiversität im Juliverlauf konnte die Migration nach der Abmahd der nachbarlichen Feldfläche (die Luzerne) Ende Juni beitragen, die besonders das Vorkommen der karnivoren Arten in der Krautschicht beinflussen konnte.

ZUSAMMENFASSUNG

1) In der Rapskultur wurden 114 Arten aus 19 Familien in 4409 Individuen festgestellt. Die Mehrheit gehört zu den charakteristischen Käferarten der Agroökosysteme.

2) Die Artendiversität der Käfer auf der Bodenoberfläche ist beträchtlich höher als in der Krautschicht, wo die an Raps trophisch gebundenen phytophagen Arten dominieren, indem im Epigaion besonders übliche karnivore Arten der Feldbiotope vorkommen. Der hohe Wert der relativen Luftfeuchtigkeit im Rapsbestand ist für den erheblichen Artenreichtum der epigäischen Familien Carabidae und besonders Staphylinidae günstig.

3) Die Entwicklung der Käferfauna des Rapsfelds wurde in drei Saisonaspekte geteilt. Als prevernale Periode gilt der Zeitraum bis zur Bildung der Blütenknospen. Sie ist durch relativ hohe Artendiversität und Dominanz besonders der karnivoren Arten der Bodenoberfläche charakterisiert. Die vernale Periode umfasst die einzigen Rapsphänophasen (Anfang, Verlauf, Ende des Blütens) und ist durch die niedrige Artendiversität und Dominanz der Arten, die trophisch an Raps gebunden sind, bestimmt. Aestivale Periode umfasst den Zeitraum nach dem Verblühen bis zur Ernte. Sie ist durch den Rückgang der trophisch an Raps gebundenen Imagines dominanter Arten, durch Aufstieg der karnivoren Arten und durch maximale Artendiversität charakterisiert.

4) Die Artenzusammensetzung in der Käfersynusie ist im Einklang mit der allgemeinen Vorstellung über das Artenspektrum der hochproduktiven Monokultur.

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A RE – EXAMINATION OF PROTURAN GENITALIA

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A b s t r a c t. The male and female genitalia of Protura are homologised. They are composed from six homologous parts in both sexes. A comparison with the six segmented genitalia of Diplopoda was made. These structures are homologised with the six segmented legs in Protura and Diplopoda.

T u x e n (1964) draws attention to the curiosity of Proturan genitalia having similar construction in both sexes. T u x e n credits the observations of B e r l e s e (1909) and P r e l l (1913) and refers to their terminology to which he adds his own. This combination of terms has been adopted by subsequent Proturan specialists, including in the major workers of N o s e k (1973) and I m a d a t é (1974).

The similarity between male and female genitalia in the Protura is further demonstrated by extending and separating apparently fused and retracted genital segments in the genus *Eosentomon*. This genus has a form of genitalia from which those of other Protura might be assumed to have been derived by reduction and fusion of component segments. In *Eosentomon* the condition of these segments appears to be as follows:—

In both sexes, the first three pairs of segments of genitalia are medianly fused to form the rings. The three rings in both sexes are fused to form single tubes. In the females ,the fourth pair of segments are separate from each other but closely attached to the end of this tube. In the male, the fourth pair of segments are fused to each other but telescoped deeply inside the tube formed by segments one, two and three. To the fourth pair of segments in the male, are closely attached the fifth segments which are separate from each other. To the male fifth segments are attached the long, filiform, sixth segments. In the female, the sixth segments are also long and filiform but fused to the pair of fifth segments. It is only the fifth and sixth segments of the female which retract into the apical portion of the tube formed by segments one, two, three and four. In the male, the fourth, fifth and sixth segments retract deeply into the tube formed by segments one, two and three.

It is unquestioned that male and female genitalia in Protura are similarly constructed. It is demonstrated that each is formed from six parts. The similarity in size and form of these parts, which is particularly apparent with the basal and apical segments, suggests that they are homologous. By comparing the six segments of male and female Protura, it is possible to postulate a common form from which both sexes have been derived. Evidence indicating what may have been the nature of this form may be found in other Arthropods to which Protura also belong.

Six segmented genitalia occur among Arthropods and have been well described and illustrated by K r a u s (1966) for the Diplopods. The Protura resemble Myriapods in having rests of abdominal legs in the adult, unlike the situation in the Insecta. Indeed the genitalia of Diplopods have been shown to be modified abdominal legs. Like the Diplopods figured by K r a u s the Protura have

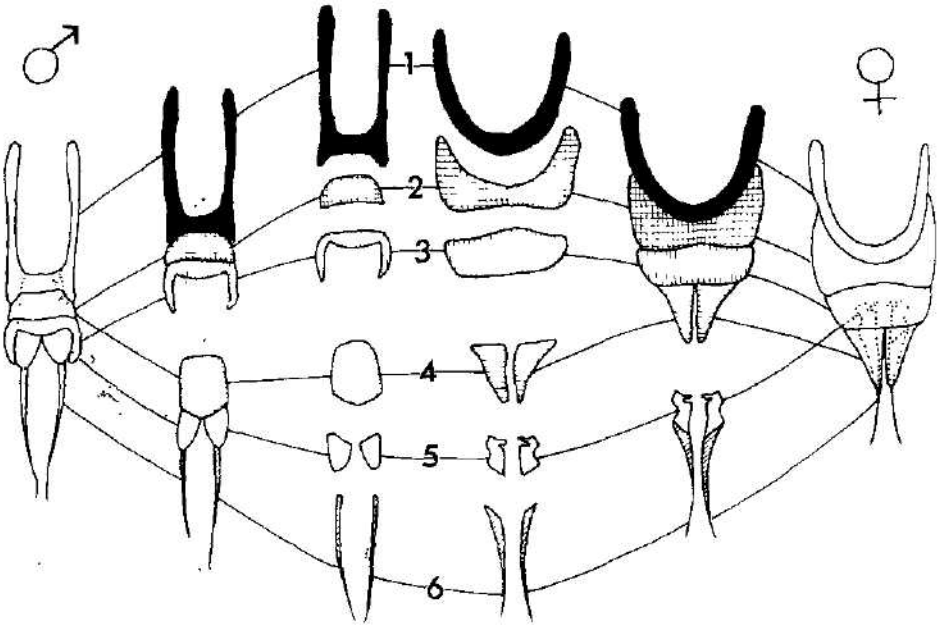

Fig. 1. Homology of segments in genitalia of *Eosentomon* (Protura). For the homology see Tab. 1.

six-segmented legs and six-segmented genitalia. If the Proturan genitalia have not been derived from abdominal legs, it is necessary to postulate the complete degeneration of one pair of six-segmented appendages and the complete evolution of another. There are Protura genera with genitalia less developed than those figured but in other respects these are considered to be more highly evolved genera. If this generally held assumption is correct, it is likely that the "less developed" genitalia are derived from six-segmented ancestors, not that they are evolving into such forms. It therefore follows that not only are male and female genitalia homologous to each other and to those of Diplopods but that Proturan genitalia are also homologous to legs.

If insect genitalia have otherwise evolved, this strengthens the evidence for the relationship between the Protura and Diplopods and weakens the case for classifying the Protura with the Insecta.

It must be admitted that Proturan genitalia are difficult to resolve with the light microscope and may be variously interpreted. Slides of *Eosentomon* identified by T u x e n and I m a d a t é show structures which are figured by these authors and by N o s e k (1973 figs 15A, 16A). The present diagrams are based on these specimens and figures. It is hoped that when micro-manipulative

Table 1. The terminology of some six-segmented appendages of which the homology is questioned

Segment	Protura male genit. (Tuxen et al.)	Protura female gen. (Tuxen et al.)		Protura leg (Tuxen et al.)	Glomeris leg (Schubart) Thyropygus leg (Krishan)	Diplopod leg (Kraus)
1	Basal apodeme	Basal apodeme		Coxa	Coxa	Basipodite
2	Basiperiphallus	Perigynium		Trochanter	Prefemur	Praefemur
3	Aeroperiphallus	Unnamed		Femur	Femur	Femur
4	Stipes	Stylus		Tibia	Postfemur	Postfemur
5	Basistylus	Caput processus & processus sternalis	fused	Tarsus	Tibia	Tibia
6	Acrostylus	Filum processus	fused	Praetarsus	Tarsus	Tarsus

and scanning electron microscopes techniques are further advanced and fresh specimens of *Eosentomon* and other Protura are available, that the subject can be investigated in more detail.

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REVIEW OF CAPILLARIID NEMATODES (CAPILLARIINAE) PARASITIC IN AMPHIBIANS AND REPTILES. PART 2. GENUS AMPHIBIOCAPILLARIA

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A b s t r a c t. Based on studies of type and other materials of nematodes of the subfamily Capillariinae from amphibians and reptiles, all species of the genus *Amphibiocapillaria* Moravec, 1982 are reviewed. North American species *Capillaria tenua* Mueller, 1932, *C. brevicollis* Walton, 1935, *C. inequalis* Walton, 1935 and *C. brachyauchenia* Walton, 1935 are newly synonymized with the European species *Amphibiocapillaria tritonispunctati* (Diesing, 1851). Three species, *Capillaria bufonis* Morishita, 1926, *C. freitaslenti* Araujo et Gandra, 1941 and *C. serpentina* Harwood, 1932, are transferred to *Amphibiocapillaria*. All species studied by the present author are redescribed and illustrated and the taxonomy, range of hosts and geographical distribution of *Amphibiocapillaria* members are discussed. Keys to the species of *Amphibiocapillaria* parasitic in amphibians and reptiles are also provided.

This paper is a continuation of the author's earlier work (M o r a v e c 1986) presenting the results of a revision of capillariid nematodes from amphibians and reptiles. It reviews the species belonging to *Amphibiocapillaria*, including the parasites of both Amphibia and Reptilia.

II. Genus *Amphibiocapillaria* Moravec, 1982

D i a g n o s i s: Stichosome composed of great number (more than 50) of short stichocytes arranged in single row; nuclei of stichocytes in posterior part of stichosome usually irregularly arranged, not forming one continuous longitudinal row; lateral caudal alae in male absent; posterior end of male with small membraneous bursa supported by pair of lateral digital projections (rays) dorsally bent along posterior border of bursa; dorsal caudal process absent; pair of large adanal papillae present; spicule with numerous rough transverse grooves on its surface; spicular sheath spinose; vulvar appendage present or absent; parasites of intestine of amphibians and reptiles.
T y p e s p e c i e s : *A. tritonispunctati* (Diesing, 1851)

Key to species of *Amphibiocapillaria* from amphibians:

1 Outer layer of egg wall thick, with distinct sculpture; parasites of intestine . 2
-- Outer layer of egg wall thin, with smooth surface; parasites of liver . . . . . *A. tritoniscristati*
2 Vulva of female provided with small, bell-shaped vulvar appendage, length of spicule 0.53 mm; parasites of frogs (Anura) in Europe . . . *A. costacruzi*
-- Vulva of female without bell-shaped appendage 3
3 Length of spicule at most 0.37 mm; parasites of salamanders (Caudata), rarely

of frogs; Europe, Japan, North America . . . . . *A. tritonispunctati*
— Length of spicule 0.43—0.65 mm; parasites of frogs (Anura); eastern Asia (Japan, China) . . . . . , *A. bufonis*

1. *Amphibiocapillaria tritonispunctati* (Diesing, 1851) Moravec, 1982 (Figs. 1—3)

Syn.: *Trichosomum tritonis punctati* Diesing, 1851; *T. tritonis* Solger, 1877, partim; *Trichosoma filiforme* Linstow, 1885; *T. tritonis* Linstow, 1909; *Capillaria tenua* Mueller, 1932; *C. brevicollis* Walton, 1935; *C. inequalis* Walton, 1935; *C. brachyauchenia* Walton, 1935.

Decsription (modified from Moravec and Lomakin 1982): Medium sized nematodes; head end narrowed, rounded, provided with inconspicuous mouth papillae. Two very distinct lateral bacillary bands extending along almost whole body. Stichosome formed by single row of about 100 short stichocytes with large nuclei; nuclei not arranged in one continuous row, especially in posterior part of stichosome, being shifted alternately to right and left sides of stichocytes.

Male (14 specimens): Length of body 5.90—12.78, maximum width 0.045—0.082. Maximum width of lateral bacillary bands 0.030—0.033. Length of entire oesophagus 3.32—6.12 (50—55 % of body length). Length of muscular oesophagus 0.315—0.530, distance of nerve ring from anterior extremity 0.096—0.120. Spicule except for its distal end strongly sclerotized, with numerous rough transverse grooves on its surface; proximal end of spicule moderately expanded, distal end rounded. Length of spicule 0.300—0.366, width 0.009—0.012. Evaginated spicular sheath up to 0.075 long and 0.021 wide; its surface covered by numerous small, flat spines. Tail 0.009 long, rounded, provided with wide cuticular membrane forming bursa. Bursa supported by two lateral, dorsally bent rays. Pair of large, round subventral papillae situated on either side of cloacal opening.

Female (10 specimens): Length of body of gravid females 9.08—13.32, maximum width 0.068—0.109. Width of bacillary bands at mid-body 0.024—0.030. Length of entire oesophagus 3.47—5.88 (41—44 % of body length). Length of muscular oesophagus 0.405—0.558, distance of nerve ring from anterior end 0.090—0.120. Vulva situated 0.045—0.135 below oesophagus end level. Vulvar lips not elevating or only anterior lip slightly elevating. Eggs in uterus arranged in one row near vulva, more distant eggs in several rows. Fully developed eggs barrel-shaped, without protruding polar plugs. Egg wall two-layered, inner layer thin, hyaline, outer layer thick, with sparse irregular sculpture on surface; in optical section, outer layer appearing to contain fine transverse canals reaching to inner layer of egg wall. Outer layer of younger eggs very thin, smooth; polar plugs distinctly protruding in these eggs. Content of mature eggs from uterus uncleaved, sometimes cleaved, however, into several blastomeres. Length of mature eggs 0.063—0.075, width 0.030—0.033; thickness of egg wall 0.003—0.005, height of polar plug 0.006. Posterior end of body rounded, anal opening almost terminal. Length of rectum 0.204—0.299.

Localization: intestine.

Hosts: Caudate amphibians (Caudata) of the families Salamandridae, Hynobiidae, Plethodontidae and Amblystomidae — *Triturus vulgaris* (type host), **T. alpestris*, **T. cristatus*, **T. vittatus*, **T. pyrrhogaster*, **T. viridescens*, **Mertensiella caucasica*, *Hynobius nebulosus tokyensis*, *H. stejnegeri*, *Onychodactylus japonicus*, *Gyrinophilus porphyriticus*, *Pseudotriton ruber*, *Typhlotriton*

*spelaeus, Desmognathus fuscus, D. ochrophaeus, D. quadramaculatus, Plethodon glutinosus, Eurycea lucifuga, *Amblystoma opacum.* According to Yamaguti (1961), it is reported from North America also from the frogs *Rana clamitans* and *R. palustris;* however, these records need verification.

Distribution: The present revision indicates that *A. tritonispunctati* is a holarctic species, widely distributed in Europe, Asia and North America. In Europe it has been reported under various synonyms (or erroneously identified from the territory of France (Dujardin 1843, 1845), Germany (Solger 1877, Linstow 1885, Moravec and Lomakin 1982), Poland (Kozlowska 1960), Czechoslovakia (Baruš and Groschaft 1962, Baruš et al. 1963, Vojtková 1963, 1976, Moravec and Lomakin 1982), Austria (Krabbe 1857), Hungary (Babos 1954), European part of the USSR (Moravec and Lomakin 1982, Lomakin 1982), Denmark (Frandsen 1974) and Great Britain (Baylis 1928). From Asia it has been found in Trans-Caucasia (Georgia) in the USSR (Moravec and Lomakin 1982, Lomakin 1982) and in Japan (e. g. Wilkie 1930, Pearse 1932, Uchida 1976). In North America it is known from the territory of the USA (Ohio, North Carolina, South Carolina, Pennsylvania, Alabama, Georgia, Tennessee, Missouri, Massachusetts, Michigan, New York) (e. g. Mueller 1932, Walton 1935, Rankin 1937, Jackson and Beaudoin 1967, Dyer and Peck 1975, Catalano et al. 1982).

Specimens: Zoologisches Museum der Humboldt-Universität, Berlin — syntypes of *T. filiforme* (Kat. Nr. 4402) and other specimens (Kat. Nr. 6525); Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice; Faculty of Natural Sciences (Chair of Zoology), J. E. Purkyně University, Brno; Helminthological Laboratory of the Academy of Sciences of the USSR, Moscow; British Museum (Nat. Hist.), London — specimens from Japan (leg. A. S. Pearse — No. 1931.3.12.1—10) and from Britain (leg. M. G. L. Perkins — No. 1924.3.13.117—118); USNM Helm. Coll., Parasitology Institute, USDA, Maryland — syntypes of *C. brevicollis* (Cat. No. 405 40) and *C. inequalis* (405 41) and specimens designated as *C. tenua* (Cat. No. 322 58).

Comments: The above description of *A. tritonispunctati* after Moravec and Lomakin (1982) was based on the European specimens from *Triturus* spp.; conspecific nematodes from the Caucasian salamander *M. caucasica* were noted for the generally smaller body and organ measurements, the length of males being only 2.5—4.8 mm, that of their spicules 0.21—0.33 mm (see also Lomakin 1982); these differences are probably associated with the different sizes of body of the hosts (a space factor).

A. tritonispunctati was established by Diesing (1851) by the indication based on the previous Dujardin's (1845) description of female nematodes found in the intestine of *Triturus vulgaris.* Later this species was reported from Europe mostly under its synonym *Capillaria filiformis* (Linstow, 1885). More detailed data on the history of this species have been provided by Moravec and Lomakin (1982), who redescribed it and synonymized with it several other species; the authors have also indicated that, in some cases, this species was mistaken for *A. tritoniscristati,* a liver parasite of newts; consequently, the findings of the young or adult capillariids from the intestine of *Triturus cristatus* reported by Krabbe (1857), Solger (1877) and Babos (1954) related, in fact, to this species. In 1982, Lomakin added some data on the morphology of these nematodes and transferred this species from *Capillaria* to *Thominx;* however, according to Moravec (1981), *Thominx* Dujardin,

Table 1. Comparison of *A. tritonispunctati* with North American species *C. tenua*, *C. brevicollis* and *C. inequalis* (own data in brackets)

	A. tritonispunctati (after Moravec and Lomakin 1982)		*C. tenua* (after Mueller 1932)		*C. brevicollis* (after Walton 1935)		*C. inequalis* (after Walton 1935)	
	♂♂	♀♀	♂	♀	♂♂	♀♀	♂♂	♀♀
Lenth of body	5.90 – 12.78	9.08 – 13.32	7.5	10	4 – 5.5 (5.79)	6.3 – 6.6 (6.6 – 6.7)	6.77 (6.28)	11.44 – 13.17 (12.02
Width of body	0.045 – 0.082	0.068 – 0.109	0.068	0.096	0.035 – 0.04 (0.068)	0.04 (0.095)	0.045 (0.72)	0.054 – 0.064 (0.081)
Length of entire oesophagus	3.32 – 6.12	3.47 – 5.88	3.75	3.5	1.85 – 2.61 (2.97)	2.45 – 2.84 (2.72 – 2.86)	3.24 (3.25)	3.8 – 4.96 (3.84)
No. of stichocytes	some 100 (125)		90	110	40 – 45 (?)	48 – 52 (?)	52 – 54 (?)	70 – 75 (?)
Length of spicule	0.300 – 0.366	–	0.032	–	0.196 – 0.256 (0.294)	–	0.238 (276)	–
Transverse groovos on spicule	present		present		(present)		(present)	
Type of spicular sheath	spiny		spiny		spiny		spiny	
Size of eggs:								
length		0.063 – 0.075		0.052		0.05 – 0.052 (0.063 – 0.072)		0.055 – 0.06 (0.063 – 0.072)
width		0.030 – 0.033		0.024		0.026 (0.039 – 0.042)		0.022 – 0.026 (0.036 – 0.039)
Hosts	*Triturus, Hynobius, Onychodactylus*		*Triturus viridescens*		*Triturus viridescens*		*Triturus viridescens Amblystoma opacum*	
Distribution	Eurasia		USA		USA		USA	

1845 is a synonym of the genus *Capillaria* Zeder, 1800. Moravec (1982) determined *A. tritonispunctati* to be the type species of *Amphibiocapillaria*.

In 1932, Mueller described a new species, *Capillaria tenua*, from the intestine of *Triturus viridescens* from the USA (Syracuse, N. Y.). The author mentions that it is impossible to make a comparison of *C. tenua* with European species until the original specific materials from European newts are revised; he considered it improbable that some European capillariid might be identical with *C. tenua*, because the distribution of *T. viridescens* is limited to North America. Although I did not succeed in obtaining the type specimens of *C. tenua*, I had at my disposal two specimens (young females), designated as *C. tenua*, from the type host from Beltsville, Md. (coll. by Krull, 6. 8. 1932) from the US National Museum (Cat. No. 322 58); this material was determined by Chitwood and Mueller in 1932. It is apparent from the original description of *C. tenua* (see also Table 1), and it was also confirmed by the study of the specimens in question, that there are no morphological differences between this North American species and *A. tritonispunctati* from Europe; the characteristic features of the latter species are for example the structure of the stichosome, the spicule, eggs, the spiny spicular sheath, the terminal anus in female, etc. (Fig. 3); the number of stichocytes in one of the studied specimens of *C. tenua* (a female 4.8 mm long) was 120. From these reasons I consider *C. tenua* Mueller, 1932 a junior synonym of *A. tritonispunctati* (Diesing, 1851).

Also two other North American species, described by Walton (1935), *C. brevicollis* (renamed *C. brachyauchenia* by the author in the same year) and *C. inequalis*, proved to be identical with *A. tritonispunctati*. Walton (1935) differentiated these species from *C. tenua* principally on the basis of the size of body and the number of stichocytes. A reexamination of the type specimens of *C. brevicollis* and *C. inequalis* from the US National Museum (Cat. Nos. 405 40 and 405 41) showed that these represented young nematodes morphologically identical with *A. tritonispunctati* (see Fig. 3). Due to a poor condition of the specimens it was not possible to determine stichocyte numbers, but it is probable that these were given erroneously in the original description; it is rather difficult to establish the stichocyte numbers in *A. tritonispunctati*, and then only according to the numbers of nuclei, but these are not always well visible. The size of the spicule in both species is similar to that in the specimens of *A. tritonispunctati* from *M. caucasica* (see Moravec and Lomakin 1982, Lomakin 1982). Since also the hosts of both these species (*T. viridescens*) are closely related with the European hosts of *A. tritonispunctati*, I consider all the three forms to be conspecific.

In addition to already mentioned materials, there were also examined the specimens designated as *C. filiformis* from *T. pyrrhogaster* from Japan, now housed in the British Museum (leg. A. S. Pearse). These specimens proved to be fully morphologically identical with *A. tritonispunctati*; their stichosome was composed of more than a hundred of short stichocytes, the length of spicule was 0.300—0.357 mm, the spicular sheath was spinose, and the structure of the male tail and that of eggs was typical of this species.

Gravid females of *A. tritonispunctati* from *T. cristatus* (designated as *C. filiformis*) from Great Britain (Waterbeach, Cambs.), collected by M. G. L. Perkins in 1923 and now deposited in the British Museum, were used for study of a detailed structure of the stichosome of this species. The number of stichocytes was 125 in one of these female nematodes. The nuclei are mostly arranged in

one row in anterior part of the stichosome, being there subdivided into two transverse annuli; a large nucleus is usually found in the anterior one or almost in the centre of the stichocyte. In the posterior part of the stichosome, the nuclei are not arranged in one longitudinal row and anly some of the stichocytes are subdivided here into two annuli (Fig. 2).

This species is very similar by its morphology to the palaearctic species *A. bufonis* and *A. costacruzi* parasitizing frogs.

2. *Amphibiocapillaria bufonis* (Morishita, 1926) comb. n.

Syn.: *Capillaria bufonis* Morishita, 1926.

Description (adapted from Morishita 1926, measurements according to Yamaguti (1941) in brackets): Head end conical. Stichosome formed by stichocytes with large nuclei. Two large glandular cells present at junction of oesophagus and intestine. Ratio of anterior oesophageal part of body to posterior one approximately 2:3 in both sexes.

Male: Length of body 8.5—9 (10.5—12.3), maximum width 0.055 (0.06—0.07). Length of entire oesophagus 4—4.1 (4.5—4.7); distance of nerve ring from anterior extremity 0.082—0.091. Posterior end of body provided with cuticular membrane forming small bursa. Spicule transversely striated, 0.43—0.65 (0.52—0.56) long and 0.009 (0.010) wide; its distal tip obtusely conical. Spicular sheath nonspiny according to Morishita (1926), while Yamaguti (1941) states that it is armed with very fine spines.

Female: Length of body 10—12 (11.0—16.8), maximum width 0.082 (0.11—0.126). Length of entire oesophagus 4.1—4.3 (3.3—5.7); according to Yamaguti (1941), stichosome formed by more than 50 stichocytes. Nerve ring 0.091—0.095 from anterior end of body. Vulva situated 4.2—4.4 from anterior end. (0.2—0.25) below oesophagus end level; vulvar lips not elevating, vulvar appendage absent. Eggs in uterus arranged in one row. Eggs barrel-shaped, with two-layered wall, size 0.065—0.073 × 0.03—0.034 (0.066—0.075 × 0.035—0.040); outer layer of egg wall with distinct superficial sculpture. Anus almost terminal, length of rectum 0.11—0.13. Posterior end of ovary situated near junction of intestine and rectum.

Localization: intestine (small intestine according to Yamaguti 1941).

Hosts: Toads and frogs (Anura) of the families Bufonidae and Ranidae: *Bufo bufo japonicus* (type host) and *Rana nigromaculata*. According to Yamaguti (1935) also in *Triturus pyrrhogaster;* but *A. tritonispunctati* might have been mistaken for *A. bufonis* in this case.

Distribution: Eastern Asia — Japan (Tokyo; Imaharu, Prov. Iyo; Siga Prefecture) (Morishita 1926, Yamaguti 1941) and China (Fujian Prov.) (Wang 1982).

Specimens: Neither type- or other specimens of *A. bufonis* were obtained for study.

Comments: This species was described for the first time by Morishita (1926) from the gut of *Bufo formosus* (= *B. bufo japonicus*) from Japan; the author mentions that this parasite is very frequent in the given host species in the surroundings of Tokyo. According to Morishita (op. cit.), this species is noted for the presence of a nonspiny spicular sheath and, accordingly, Moravec (1982) assigned it provisionally to the genus *Paracapillaria*. However, Yamaguti (1941) refers, according to Japanese specimens from the

same host species, that the spicular sheath of C. *bufonis* is spiny. This is also supported by the general nematode morphology (e. g. the structure of the stichosome, transverse grooves on the spicule, a terminal anus in female, the structure of eggs — as illustrated in the paper by Morishita (1926)), indicating an appurtenance of this species to the genus *Amphibiocapillaria*. Although Morishita (1926) writes that there are no papillae in the caudal region of the male of *C. bufonis*, the structure of the tail of this species is probably similar to that of, for example, *A. tritonispunctati*; it is obvious from Yamaguti's (1941) drawing that the bursa of *A. bufonis* is supported by two lateral, medially bent rays.

Although the morphology of *A. bufonis* is so far inadequately known, this species reminds considerably *A. tritonispunctati* from the intestine of caudate amphibians that occurs as well in Japan. According to available data, *A. bufonis* differs from this species only in possessing a longer spicule and, therefore, subsequent studies may prove their conspecificity. For the time being, I consider this species valid. *A. bufonis* can be differentiated from *A. costacruzi*, a parasite of European frogs, mainly by the absence of a vulvar appendage in females.

3. *Amphibiocapillaria costacruzi* (Travassos, 1932) Moravec, 1982 (Fig. 4)

Syn.: *Capillaria costacruzi* Travassos, 1932.

Following description based on specimens from *Rana esculenta* from Portugal, mounted as permanent preparations.

Description: Medium sized nematodes; head end narrowed, rounded. Muscular oesophagus comparatively wide. Number of stichocytes about 100. Stichocytes short, subdivided into two annuli in anterior part of stichosome, but mostly not in posterior one; nuclei of stichocytes large, arranged in one longitudinal row in anterior part of stichosome, but irregularly situated in its posterior part; always 1—2 darker, more granular stichocytes alternating with 1—2 lighter coloured stichocytes.

Male (1 complete specimen and 1 body fragment): Length of body 4.91; maximum width 0.041—0.054. Length of entire oesophagus 2.37 (49 % of body length); length of muscular oesophagus 0.300, of stichosome 2.07; stichocytes 95 in number. Nerve ring 0.090 from anterior extremity. Spicule well sclerotized, 0.525—0.530 long and 0.007—0.009 wide, at least its middle part being provided with superficial transverse grooves. Spicular sheath spiny. Tail rounded, provided with broad cuticular membrane forming small bursa supported by two lateral, medially bent rays. One pair of large round subventral papillae situated at level of cloacal opening.

Female (2 complete specimens and 1 body fragment): Body length of gravid females 6.96—8.01, maximum width 0.054—0.122. Length of entire oesophagus 2.88—3.20 (33—47 % of body length); length of muscular oesophagus 0.285—0.297, of stichosome 2.67; number of stichocytes 105. Distance of nerve ring from anterior end 0.081—0.087. Vulva visible only in one female, being situated at level of junction of oesophagus and intestine, i. e. 2.95 from anterior extremity; small bell-shaped vulvar appendage present, but its major part overlapped by nematode body in this specimen (Fig. 4D). Eggs oval, without protruding plugs, with two-layered wall; inner layer thin, hyaline, outer layer thick, with rough structure on surface; content of eggs uncleaved. Size of eggs 0.054—0.069 × 0.027—0.039, thickness of their wall being 0.003—0.005; height of polar plugs 0.005—0.006, their width 0.006. Posterior end of body tapering, with

rounded tip; length of rectum 0.075—0.120, anus terminal. Posterior end of ovary approximately at level of junction of intenstine and rectum.
Localization: intestine (small intestine according to Rodrigues et al. 1972).
Hosts: Frogs of the family Ranidae — *Rana esculenta, Rana* sp.
Distribution: Europe (Iberian Peninsula) — hitherto reported only from Portugal (Espinho; Santo Varão, Coimbra) (Travassos 1932, Rodrigues et al. 1972).

Specimens: Fundaçao Oswaldo Cruz, Rio de Janeiro — the specimens determined by Rodrigues et al. (1972) (Cat. Nos. 30.690—92).

Comments: Travassos (1932) was the first to describe this species on the specimens from the intestine of *Rana sp.* from Portugal. Later it was redescribed from the type specimens by Freitas and Lent (1935) who showed that the spicule length given in the original description was erroneous. this species is noted for the morphological features characteristic of this genus time the structure of the male tail in *C. costacruzi.* A redescription of this species, based on new materials from *Rana esculenta* from Portugal, were also provided by Rodrigues et al. (1972).

In 1982, this species was transferred by the present author to the subgenus *Amphibiocapillaria* of the genus *Schulmanela;* this subgenus is now considered an independent genus. A reexamination of the materials has confirmed that this species is noted for the morphological features characteristic of this genus (principally the structure of the stichosome, the male tail, spicules, the position of the female anus, the structure of eggs). *A. costacruzi* is very similar to *A. bufonis* and *A. tritonispunctati,* differing from them mainly in the presence of a vulvar appendage in female and, from the latter species, by a greater length of the spicule.

4. *Amphibiocapillaria tritoniscristati* (Diesing, 1861) Moravec, 1982 (Fig. 5)

Syn.: *Trichosomum tritonis cristati* Diesing, 1861; *T. tritonis* Solger, 1877, partim; *Capillaria fagei* Arvy, 1951; *C. hepatophila* Babos, 1954.

Description (according to Moravec and Lomakin 1982): Medium sized nematodes; anterior end rounded, narrowed. provided with minute mouth papillae. Two lateral bacillary bands of rough structure present, starting a short distance below nerve ring level and extending practically along whole body length. Stichosome consisting of single row of short stichocytes, some 120 in number, provided with large nuclei; alternation of dark and light coloured stichocytes not developed, whole stichosome uniformly light in colour. Posterior stichosome end of more developed females formed by very short stichocytes, some of which appearing to be doubled (in two rows). Nerve ring encircling fairly wide muscular oesophagus approximately at border of its first and second fourths.
Male (1 specimen and 3 fragments of posterior body ends): Length of body 8.00, maximum width 0.042—0.060. Length of entire oesophagus 3.36 (38 % of body length), of which muscular oesophagus being 0.300. Length ratio of oesophagus and body 1:2.3. Nerve ring 0.072 from anterior end. Surface of spicular sheath provided with numerous fine, flat conical spines. Spicule well sclerotized. light in colour, its surface smooth; length of spicule 0.159—0.189, its width 0.009—0.012; its proximal end somewhat expanded, distal end bluntly conical.

Tail rounded, very short, provided with a wide cuticular membrane forming bursa (length of membrane 0.009); latter supported by two lateral, dorsally bent rays, not touching each other by their ends. In ventral view, posterior border of proper tail widely rounded or with its middle region slightly depresed. Large round subventral papilla present on either side of cloacal opening.

Female (only numerous body fragments of young and gravid females): Longest body fragment (head end) of young female 2.17, length of its muscular oesophagus 0.270, incomplete stichosome comprising 73 stichocytes. Anus of young female slightly subterminal (almost terminal). Body fragments of gravid females very short; width of body 0.081—0.082. Two lateral bacillary bands present, of rough structure. Vulvar lips not elevated. Postvulvar region of body mostly filled up with uterus containing numerous eggs. Fully developed eggs barrel-shaped, with not protruding polar plugs. Egg wall two-layered; inner layer hyaline, strongly refractile: outer layer very thin, somewhat thicker near egg poles only, with smooth surface. Content of mature eggs from uterus uncleaved. Length of mature eggs 0.060—0.066, width 0.024—0.027; thickness of wall near their mid-length about 0.002, height of polar plug 0.005, its width 0.007.

According to the data by Arvy (1951) and Babos (1954) the body length of males attains 20—21 mm, that of females 27—40 mm, exceptionally up to 60 mm.

Localization: liver.

Hosts: Newts — most often **Triturus cristatus* (type host), but also *T. vulgaris* and *T. helveticus* (fam. Salamandridae).

Distribution: Europe; so far recorded from the territory of Austria (Krabbe 1857), Hungary (Babos 1954), Czechoslovakia (Baruš et al. 1963, Vojtková 1963, 1976, Moravec and Lomakin 1982), France (Arvy 1951) and RFG (Waible and Kracht 1964).

Specimens: Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice; Faculty of Natural Sciences (Chair of Zoology), J. E. Purkyně University, Brno.

Comments: This species was established by Diesing (1861) by the indication based on a description of female nematodes given by Krabbe (1857), who had found this parasite in the liver of *Triturus cristatus* from the surroundings of Vienna; since only nematode fragments were obtained, this description was very poor. Later the same species was described from Europe from *Triturus helveticus* and *T. vulgaris* from France (Arvy 1951) and from *T. cristatus* from Hungary (Babos 1954) as *Capillaria fagei* and *C. hepatophila*, respectively. Both these species were synonymized with *C. tritoniscristati* by Moravec and Lomakin (1982). These authors refer that it is necessary to consider also the unidentified eggs from the liver of *T. cristatus* found by Waible and Kracht (1964) in FRG as conspecific with *C. tritoniscristati*, whereas the juvenile nematodes reported by Krabbe (1857) and Babos (1954) from the intestine of *T. cristatus* belonged, apparently, to the species *C. tritonispunctati*. Moravec (1982) assigned *C. tritoniscristati* to the subgenus *Amphibiocapillaria* that is now considered an independent genus.

This species differs markedly in some morphological features (e. g. the structure of the spicule and eggs, the length ratio of the oesophagus and the body, the size of the body) and in its localization in the host from other *Amphibio-*

capillaria members and future studies may show it necessary to establish an independent subgenus to accomodate this species. A detailed redescription of *A. tritoniscristati*, based on new materials, is desirable, because the present knowledge of the morphology of this species is very incomplete, mainly as to an exact structure of the stichosome and spicules and a metrical variability.

Key to species of *Amphibiocapillaria* from reptiles:

1 Parasites of digestive tract of lizards (*Tropidurus*) in South America (Brazil). Size of eggs 0.053 × 0.024 mm. Spicule not observed . . . . . *A. freitaslenti*
— Parasites of digestive tract of freshwater turtles (*Chelydra, Chrysemys, Sternotherus*) in North and Central Americas (USA, Cuba). Size of eggs 0.057—0.078 × × 0.030—0.036 mm. Length of spicule 0.24—0.25 mm . . . . . *A. serpentina*

1. *Amphibiocapillaria freitaslenti* (Araujo et Gandra, 1941) comb. n.

Syn.: *Capillaria freitaslenti* Araujo et Gandra, 1941.

Description (adapted from López-Neyra 1947): Cuticle whitish, without lateral bacillary bands. Length of oesophagus 2.4—4.9, length of its muscular portion 0.355. Nerve ring 0.134 from anterior end of body.
Male: Length of body 6.6—9.2, width 0.032; length ratio of anterior oesophageal par of body and posterior part of body 1 : 1.75—2.8. Caudal end with well developed membraneuos bursa whose width attaining 0.041; bursa supported by one pair of medially bent papillae. Spicule not observed. Spicular sheath spiny, diameter of spines being 0.008; cloacal opening terminal.
Female: Length of body 10.3—14, width 0.048. Length ratio of anterior oesophageal part of body and posterior part of body 1 : 1.14—1.85. Vulva with two elevated lips, situated 0.124—0.172 below level of oesophagus end; length of vagina 0.331. Size of eggs in uterus 0.053 × 0.024. Caudal end obtuse, anus terminal.
Localization: small intestine.
Host: Lizard, *Tropidurus torquatus* (fam. Iguanidae).
Distribution: Brazil (Goias) (Araujo and Gandra 1941).

Specimens: The type specimens of this species were lost according to the information provided by Prof. J. J. Vicente.

Comments: Due to its inadequate description, an assignment of this species to the genus *Amphibiocapillaria* is only tentative; its belonging to the latter genus is suggested by the presence of a membraneous bursa with a pair of inwardly bent papillae in the male, the spiny spicular sheath and the terminal anus in the female. *A. freitaslenti* is the only capillariid species parasitic in lizards (Sauria).

2. *Amphibiocapillaria serpentina* (Harwood, 1932) comb. n. (Fig. 6)

Syn.: *Capillaria serpentina* Harwood, 1932.

Following description based on specimens from *Chelydra serpentina* from the USA, kindly provided by Dr. T. R. Platt; measurements of the only female from *Chrysemys decussata* from Cuba given in brackets.

Description: Medium sized nematodes; head end narrowed, rounded; oral papillae indistinct. Two lateral bacillary band of rough structure extending along almost whole body length. Stichosome formed by single row of relatively

short stichocytes mostly subdivided into 2—5 transverse annuli and provided with large nuclei; 1—2 lighter coloured stichocytes alternating always with one darker (more granular) stichocyte; stichocytes 80—95 in number. Pair of large wing-like cells present at junction of oesophagus and intestine.

Male (3 specimens): Length of body 6.64—7.29, maximum width 0.050—0.054. Length of entire oesophagus 3.50—3.62 (48—55 % of body length). Length of muscular oesophagus 0.309—0.330, distance of nerve ring from anterior end 0.090—0.099. Number of stichocytes 83—85. Spicule 0.240—0.249 long and 0.006—0.009 wide; first two thirds of spicule heavily sclerotized, densely transversely wrinkled on surface, its distal third weakly sclerotized, smooth; posterior end of spicule rounded. Spicular sheath spiny. Posterior end of body rounded, provided with short cuticular membrane forming bursa. Bursa supported by two lateral rays inwardly bent. One pair of large round subventral papillae situated at sides of cloacal opening. Length of tail including bursa 0.009.

Female (4 specimens): Body length of gravid females 7.89—11.06 (7.07), maximum width 0.068 (0.081). Width of lateral bacillary bands at oesophagus region (0.018). Length of entire oesophagus 3.59—3.78 (3.50) (34—47 % (43 %) of body length). Length of muscular oesophagus 0.360—0.405 (0.423), distance of nerve ring from anterior extremity 0.096—0.105 (0.102). Number of stichocytes 79—95 (about 80). Vulva situated 0.012—0.045 (0.030) below level of oesophagus end, its anterior lip usually somewhat elevating. Eggs in uterus arranged in one row. Fully developed eggs oval-shaped, with flat polar plugs, not protruding or only slightly protruding. Egg wall two-layered, inner layer thin, hyaline, outer layer rather thick, with irregular folds on its surface; content of eggs uncleaved. Length of mature eggs 0.057—0.078 (0.069—0.072), their width 0.030—0.036 (0.033—0.036); thickness of egg wall 0.004—0.005 (0.004—0.005), length of complete polar plug 0.003 (0.003—0.004), width 0.006—0.009 (0.004). Posterior end of body rounded, anus terminal. Posterior end of ovary reaching posteriorly to region of rectum; length of rectum 0.078—0.150 (0.114).

Localization: digestive tract — small and large intestine and rectum.

Hosts: Freshwater turtles of the families Chelydridae, Emydidae and Kinosternidae: — **Chelydra serpentina* (type host), *Chrysemys picta*, **Ch. decussata*, and *Sternotherus odoratus*.

Distribution: North and Central Americas. This species was found first in *Ch. serpentina* in Texas (Houston) in the USA (Harwood 1932), later it was recorded from the USA from three species of freshwater turtles also in Oklahoma (Williams 1953) and Virginia (Westhampton Lake, Richmond) (Platt 1983). It also occurs in Cuba where it has been reported as *Capillaria* sp. from *Pseudemys (= Chrysemys) decussata* by Baruš and Moravec (1967) and Coy Otero and Baruš (1979).

Specimens: USNM Helm. Coll., Parasitology Institute, USDA, Maryland — holotype (Cat. No. 31 709); Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice — female specimen from Cuba; Department of Biology, University of Richmond, Richmond, Va. — specimens from *Ch. serpentina* (now deposited in the Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice).

Comments: Harwood (1932) described this species on two females found in the rectum of *Chelydra serpentina* from the surroundings of Houston in Texas. Only much later there was described also the male, on the basis of materials from the type host species from Oklahoma (Williams 1953). Howe-

ver, the descriptions by these authors are poor and, therefore, this species was assigned provisionally to the genus *Capillaria* in the paper by Moravec (1982) But a recent redescription of *C serpentina*, carried out by Platt (1983) according to numerous specimens from three species of freshwater turtles from Virginia (including the type host), as well as the present reexamination of these specimens have shown that this species belongs to the genus *Amphibiocapillaria* according to its general morphology Its characteristic features are mostly the structure of the stichosome, the male tail, the spicule, the spiny spicular sheath, the terminal anus in female and the sculpture on the egg surface, the latter feature is unique within *Amphibiocapillaria* and thus the females of *A serpentina* can be easily differentiated from those of other congeneric species I found the characteristic structure of eggs and that of the stichosome also in the type specimen of *C serpentina*, whose present condition is otherwise very poor

Baruš and Moravec (1967) found one female nematode in *Pseudemys* (= *Chrysemys) decussata* in Cuba, designating it *Capillaria* sp , later on, this finding was also quoted in the paper by Coy Otero and Baruš (1979) A reexamination of this specimen showed that its general morphology, particularly the structure of its stichosome, eggs, the situation of the anus, etc was typical of *A serpentina* Since *A serpentina* is the only capillarid parasitizing turtles, being known as a common parasites of freshwater turtles in the nearby geografical region (southern USA), there cannot be any doubts that the specimen from Cuba belongs to this species

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The figures will be found at the end of this issue.

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REVISION OF J. W. MEIGEN'S TYPES OF EMPIS S. STR. (DIPTERA: EMPIDIDAE) OF THE PARIS MUSEUM, WITH AN APPENDIX ON MACQUART'S SPECIES

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A b s t r a c t. The species of *Empis* s. str. in Meigen Collection in Paris are revised. Five lectotypes are designated and two holotypes identified. *E. leucoptera* remains an unrecognized species, 3 species *(E. morosa, E. brunnipennis* and *E. lepidopus)* are redescribed as valid species. *E. lineata* Meigen (not Scopoli and Villers) is a new synonym of *E. serotina* Loew, *E. funesta* Meigen is a new synonym of *E. chioptera* Meigen; *Empis maura* Macquart (not Fabricius) and *E. andalusiaca* Engel are synonymized with *E. decora* Meigen. *E. brevipennata* and *E. subpennata* of Macquart are discussed.

INTRODUCTION

Besides the four *Empis s.* str. species *(E. ardesiaca, E. gravis, E. ptilopoda* and *E. umbrina)* described by W i e d e m a n n in M e i g e n (1822) from Portugal, altogether 16 species of the nominate subgenus *Empis s. str.* were described by M e i g e n in 1804—1838 from Europe. Most of the types may be found in Paris but some are very probably still mixed up with other specimens in the 'Old Collection' of the Vienna Museum. C o l l i n (1927, 1961)) when studying the British fauna of the Empididae revised the Meigen's Collection in Paris, but only those species occurring in the British Isles were treated. Through the kindness of Dr. Loic Matile, Paris, we have had an opportunity to study the rest of Meigen's types present in the Paris Museum, and further seven Meigen's *Empis s. str.* species are discussed in the present paper. This was necessary for the preparational work on the Empididae for the Catalogue of Palaearctic Diptera (to be issued in the Hungarian Academy, Budapest).

However, three Meigen's species have not yet been fully cleared up until now, *E. hyalinata* Meigen, 1830, *E. rapida* Meigen, 1838 and *E. modesta* Meigen, 1838. The type specimens of the above three Meigen's *Empis* s. str. species were not found by Dr. L. Matile in Paris and, according to Dr. Ruth Contreras-Lichtenberg, they are not in the Vienna Museum either.

SYSTEMATIC PART

E m p i s (s. str.) *l e u c o p t e r a* Meigen, 1804

Empis leucoptera Meigen, 1804: 221; preoccupied by *Empis leucoptera* Gmelin, 1790: 2891 (= unrecognized species of *Empis* s. lat.); not *Empis leucoptera* sensu Meigen, 1822: 27.

This species was described by Meigen actually twice, first in 1804 from both sexes as a common species ("man findet sie im Frühlinge und Sommer ziemlich häufig"), the male with "Flügel glasartig, weiss, die Adern am Vorderrande bräunlich", hind legs in ♀ as "schwach gefranzt" and the given size was "2 Linien". Later, he (Meigen, 1822) described under the same name without mentioning the first 1804 description (although this applies also to *Empis chioptera* and others) a single ♂ only, with "Flügel milchweiss — nicht bloss glasartig — mit ebenfalls weissen Adern, nur die Randader ist von der Mitte bis zur Spitze schwarz (wie bei der 20. Art /= *E. chioptera*)" and the given size was "1 1/2 Linie".

There are 1 ♂ and 1 ♀ in Meigen Collection in Paris under the name *Empis leucoptera*. The ♂, labelled "Meigen / 1080 40" and "*Empis leucoptera* ♂", is undoubtedly the male described in 1822. Wings are milk-white with all veins whitish, leaving costa dark brownish on apical half from vein R_1 to wing-tip. Even other characters given in the short 1822 diagnosis fit quite well. It means that the male does not belong to the type series of *Empis leucoptera* Meigen, 1804, and that it is the single ♂ which Meigen had before him when describing the same species 18 years later in 1822. *Empis leucoptera* ♂ of Meigen, 1822 is conspecific with *Empis* (s. str.) *albopilosa* de Meijere described in 1935 from the Netherlands and known to us also from a series of both sexes taken recently in Central Bohemia, Czechoslovakia.

The ♀, labelled "Meigen / 1080 40" and "*Empis leucoptera* ♀ Baiern", is headless and larger than the male (♂: body length 3.0 mm, wing 3.5 mm; ♀: body length without head 3.6 mm, wing 4.0 mm). *Empis leucoptera* ♀ was described by Meigen in 1804 with wings having "einen schwachen bräunlichen Anstrich, der bisweilen kaum merkbar ist" and hind legs „schwach gefranzt". The present female has wings faintly brownish with distinct dark veins, but mid and hind femora are broadly pennate on both sides, mid tibia with shorter pennation dorsally, and hind tibiae are broadly pennate ventrally on basal half and dorsally on the whole length. It is scarcely the species described in 1804 and it was very probably arranged in the collection only after 1822. Although the specimen has lost its head it is easily to be identified as a ♀ of *Empis* (s. str.) *nuntia* Meigen, a species described by Meigen from both sexes in 1838 from "Baiern".

It may be concluded that *Empis leucoptera* Meigen, 1804 remains an unrecognized species of the genus *Empis*, the type specimens being probably lost. Furthermore, it is an unavailable name as it is a primary homonym of *Empis leucoptera* Gmelin, 1790.

Empis (s. str.) *lineata* Meigen, 1804

Empis lineata Meigen, 1804: 224; not Meigen, 1822: 29; preoccupied by *Asilus lineatus* Scopoli, 1763: 364 (= unrecognized species of *Empis*, probably subgen. *Leptempis*) and *Empis lineata* Villers, 1789: 571 (= *Empis livida* Linné, 1758).

Meigen's two descriptions are somewhat misleading. The first one of 1804 gives mesonotum "bräunlich aschgrau mit vier braunen Längslinien, von welchen die mittelsten fein sind" (Meigen named the species as "Vierstrichige"), halteres "weissgelb" and wings "blassbraun mit dunkelbrauner Randlinie". Neither sex nor any origin were given; the very short diagnosis does not indicate what sex had Meigen before him when describing this species. In 1822 Meigen described both sexes, mesonotum as "fast dreistriemig...

die mittelste besteht eigentlich aus zwei dicht beisammen stehenden Linien", halteres "schwarz" in diagnosis and "schwarzbraun" in the following short description, wings as "glashelle" in ♂. The very brief description of female includes only a short entry on legs: "Die Schenkel der hintersten Beine sind unten etwas gefiedert", which does not correspond with the preserved female.

There is one ♀ in Meigen Collection in Paris labelled "Meigen / 1088 40" and "*Empis lineata* ♀" which represents a ♀ of *Empis* (s. str.) *serotina* Loew. Since *Empis lineata* Meigen, 1804 is an unavailable name, preoccupied by both Scopoli (1763) and Villers (1789), we do not hesitate to select the above ♀ as Lectotype of *Empis lineata* Meigen, 1804 (nec Scopoli, 1763 and Villers, 1789), and it was labelled so in 1985. *Empis lineata* Meigen, 1804 becomes a new synonym of *Empis serotina* Loew, 1867. It should be noted that already Frey (1954: 394) in 'Die Fliegen der Palaearktischen Region' listed *Empis lineata* Meigen as a questionable synonym of *Empis serotina* Loew.

Empis (s. str.) *decora* Meigen, 1822

Empis decora Meigen, 1822: 22

The species was relatively well described by Meigen from both sexes without given type-locality ("Aus Baumhauers Sammlung mehre Exemplare"). There is a pair in Meigen Collection in Paris, revised already by Collin (1961: 514). Both specimens are conspecific and represent the species known recently as *E. decora* Meigen, a species fully redescribed by Collin (1961: 511) including a detailed illustration of ♂ genitalia. The ♂ labelled "Meigen / 1074 40" and "*Empis decora* ♂" is hereby designated as Lectotype of *Empis decora* Meigen, 1822 and it was labelled accordingly in 1985. The Lectotype ♂ is fairly well preserved, body length 5.8 mm, wing 5.5 mm, but apical four tarsal segments on left mid and right hind leg, and tibia with tarsus of left hind leg are missing. The ♀ bears the same labels except for the different sex sign.

Empis (s. str.) *lepidopus* Meigen, 1822

Empis lepidopus Meigen, 1822: 23

Described by Meigen from a single holotype ♀ ("ein Weibchen aus der Baumhauerischen Sammlung") that is fairly well characterized by the leg pennation present on hind tibiae only: "Beine schwarz, feinborstig: die Hinterschienen gefiedert".

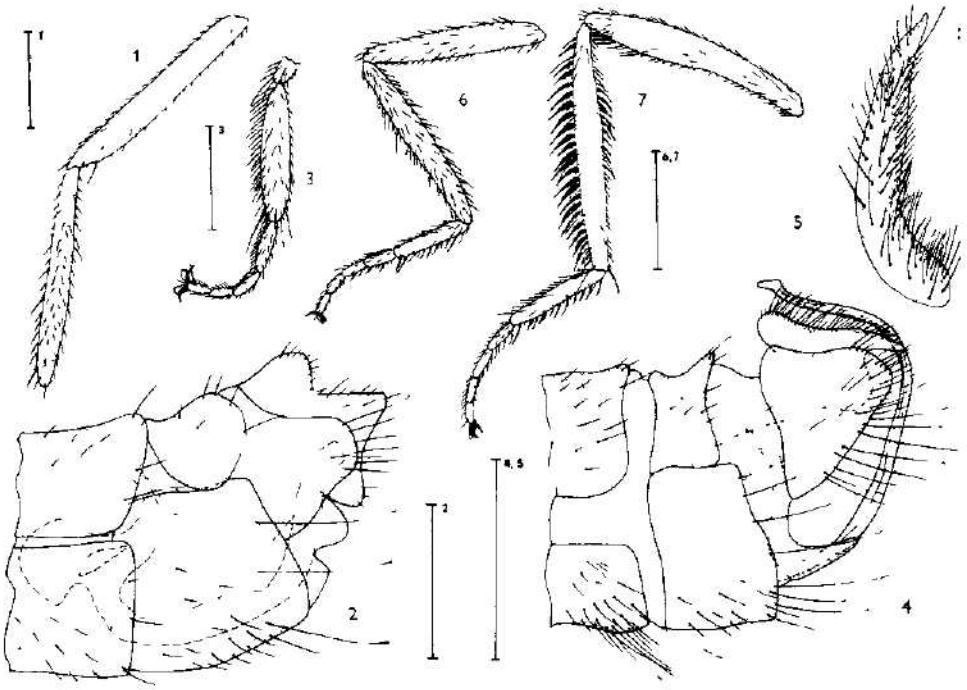
There are 6 specimens under *Empis lepidopus* in Meigen Collection in Paris. One female, labelled "Meigen / 2918 40" and "*Empis lepidopus* ♀", is obviously the holotype ♀ and it was labelled so in 1985. The series of further 1 ♂ and 4 ♀ is apparently of a later origin, each specimen bears a label "Meigen / 1079 40", the ♂ and one ♀ are labelled also "*Empis lepidopus*" with a corresponding sex sign. The four ♀, although in a rather poor condition, are all conspecific with the holotype ♀, the ♂ is a specimen of *Emis serotina* Loew. The holotype ♀ is in a perfect condition with completely preserved legs, wings and antennae.

Redescription of holotype ♀: Body length 4.6 mm, wing 5.0 mm long. 1.9 mm broad. Head grey dusted, occiput and face with black hairs, those behind mouth-opening white, longer and more numerous. Labrum slender, distinctly enlarged at base, somewhat more than twice as long as head is high.

Antennal segment 1 longer than broad, style slightly longer than half length of segment 3.

Thorax light grey dusted, densely on pleura, mesonotum with finer dusting and with three blackish subshining stripes on the lines of bristles; in dorsal view the stripes are brownish. Acr and dc bristles numerous, former biserial, latter irregularly multiserial. Scutellum with 10 bristles, 3 notopleural and 1 long humeral bristle in a group of more than 10 pale and dark hairs: also front part of notopleura and front part of mesonotum at sides covered with intermixed pale and dark hairs, with a dominance of the latter. Metapleural fan composed of many yellowish bristles with a few black intermixed

Wings brownish clouded with a narrow indistinct and somewhat darker stigma. Veins complete. Costa and radial veins dark brown, other veins light brown. Halteres yellow. Legs slender, shining dark brown, coxae light grey dusted and covered with yellowish hairs. Fore femora with only very short hairs, fore tibiae with two rows of dorsal bristles as long as tibia is deep. Mid and hind legs as in Figs. 6 and 7. Abdomen shining dark brown on dorsum, venter grey dusted, covered with vhitish hairs which are longer at sides of anterior segments.



Figs. 1 — 7. Fig. 1 — *Empis brunnipennis* Meig. holotype ♀: left mid femur and tibia (posterior view). Fig. 2—3 — *Empis morosa* Meig. lectotype ♂: 2 — genitalia (lateral view), 3 — left fore tarsus (dorsal view). Figs. 4—7 — *Empis lepidopus* Meig · 4 — ♂ genitalia (lateral view), 5 — detail of epandrium (dorsal view), 6 — mid leg of holotype ♀ (posterior view), 7 — hind leg of holotype ♀ (posterior view). Scale lines: Figs. 2 and 5 — 0 25 mm. Figs. 1, 3 and 4 — 0 5 mm, Figs. 6 and 7 — 1.0 mm.

Description of ♂: Similar to female, bristles on legs short, mid tibiae with short hairs on both sides but anterodorsally with 4 strong bristles and with a short apical bristle, ventrally with a similar bristling. Genitalia (Figs. 4 and 5) covered with dark hairs except for lateral lamellae which bear some additional yellow hairs. (The description is based on a specimen from the Loew Collection in Berlin which bears an illegible locality, date 1899 and No. 48121, standing under the name of *Empis lepidopus*. Another male labelled "Coll. Winthem, Genf" (= Genève, Switzerland) stands under the same name in the Vienna Collection.)

Variability: Some females of the Meigen's series exhibit differences in the tinge of hairs covering humeri, front part of notopleura and lateral sides of mesonotum: the light hairs are sometimes dominant. The number of scutellar bristles is 12 in on specimen. Moreover, the blackish stripes on mesonotum, well visible in the holotype ♀, are less distinct in two specimens; however, the brown pollination is always present.

Differential diagnosis: *Empis lepidopus* is very similar to *E. serotina* Loew and *E. genualis* Strobl, particularly having the similarly pale halteres, the pale abdominal pubescence, the same colour and density of the dusting of mesonotum, and the brown abdomen. *E. genualis* has also shining brown legs. However, abdomen is greyish dusted in *E. serotina*, and shining brown both dorsally and ventrally in *E. genualis*. *E. serotina* differs in having only pale hairs on humeri, lateral sides of mesonotum and front part of notopleura, the darker halteres with greyish dusted knobs, and also both mid and hind femora are pennate in ♀. *E. genualis* differs especially in the absence of the fine pubescence on humeri and mesonotum, scutellum with 4 to 6 bristles, and all legs including fore metatarsi and mid coxae are long and broad pennate in ♀ (hind coxae with single flattened bristles only). The bristling of legs is distinctly longer in *E. genualis* ♂, and femora are yellowish at tip in both sexes.

Empis (s. str.) *morosa* Meigen, 1822

Empis morosa Meigen, 1822: 26

The species was described by Meigen from both sexes, one ♂ ("Ich erhielt das Männchen aus der Baumhauerischen Sammlung") and more females ("das Weibchen wurde mehrmalen in hiesiger Gegend gefangen"). There is a series of 1 ♂ and 4 ♀ in Meigen Collection in Paris standing under the name *Empis morosa*. The ♂, labelled "Meigen / 1079 40" and "*morosa* ♂", is fairly well preserved (only left wing and apical four tarsal segments of right hind leg are missing) and all the given details of the original description fit quite well to this specimen. We have dissected the genitalia and proved it to be a distinct species as redescribed below.

Te series of 4 ♀ consists of 2 different species, although the Meigen's short diagnosis "bei dem Weibchen sind die Schenkel der Mittel- und Hinterbeine gefiedert" fits to both of them. The first 3 ♀ in a row with black halteres and smaller size should be those taken by Meigen for *morosa*, the fourth ♀ has pale halteres and represents a female of *Empis nigripes* Fabr.

All females are identically labelled with the single male ("Meigen / 1079 40"), the first ♀ bears a label "*Empis morosa* ♀"; this and the second ♀ are fairly well preserved and are indistinguishable from the females of *Empis caudatula*

Loew. Considering that the females are of a different origin than the single male, and are probably conspecific with *E. caudatula* (one with *E. nigripes*), the male is hereby designated as Lectotype of *Empis morosa* Meigen, 1822 and it was labelled so in 1985. The female sex of *E. morosa* should be taken for unknown until it is taken in copula with the corresponding male.

Redescription of lectotype ♂: Body length 3.6 mm, wing 3.8 mm. Head black, vertex and occiput covered with black hairs, lower part of occiput, face and the area round the mouth-opening with long black hairs. Antennae black, segment 3 conical, slightly more than twice as long as style. Labrum brownish black and slender, twice as long as head is high.

Thorax black, covered with grey dust on mesonotum and with somewhat lighter dusting on pleura. Mesonotum without distinct stripes, acr and dc bristles short and biserial. Scutellum with 4 bristles, metapleural fan black, 2 long humeral bristles in a group of several shorter black hairs, 3 notopleural bristles, front part of notopleura with black hairs.

Wings almost clear or slightly whitish from some views, costa and radial veins dark brown, other veins whitish. Anal vein complete, reaching the wing-margin, stigma yellowish and rather indistinct. Halteres blackish.

Legs shining black, fore and hind metatarsi thickened. Fore metatarsus covered with short hairs except for long dorsal apical bristles (Fig. 3). Ciliation on fore femora is apparently broken. Fore tibiae dorsally with two rows of long bristles becoming longer apically, ventrally with only short hairs. Mid femora dorsally with short hairs, ventrally with two rows of long bristles. Mid tibiae dorsally with 2 long bristles in median third, anteroventrally with 3 long bristles, posteroventrally with a row of short bristles. Mid metatarsus twice as long as a tibial dorsal apical bristle. Hind femora dorsally with an irreguplar row of short bristles, anteroventrally on apical half with a row of longer bristles about as long as femur is deep. Hind tibiae dorsally on apical half with several long bristles, ventrally with numerous short bristles. Hind metatarsi covered with short hairs, long bristles present anterodorsally and at tip of metatarsus.

Abdomen shining black, covered with black hairs, dorsum indistinctly dark grey dusted, the dusting on venter rather dense. Genitalia as in Fig. 2.

The male of *E. morosa* is very similar to *E. caudatula* Loew, possessing also black halteres, black abdominal pubescence, 4 scutellar bristles, shining black mesonotum, and black hairs on humeri and notopleurae. Besides the differences on genitalia *E. caudatula* differs especially by the longer dorsal bristles on fore metatarsus, by the presence of only 1 long humeral bristle, and 3 to 4 long dorsal bristles on mid tibiae; wings including veins (except costa and radial veins) are intensively whitish in *E. caudatula*.

Besides the Lectotype ♂ *Empis morosa* Meig. is known to us also from a single male taken in central Bohemia, Czechoslovakia.

Empis (s. str.) *brunnipennis* Meigen, 1822

Empis brunnipennis Meigen, 1822: 32

A species described by Meigen from a single female without given locality or any origin. An overlooked species not mentioned by Collin (1961), Frey (1954: 408) listed it under unrecognized species of *Empis* (mistakenly as *brunnipes*). There are 2 specimens under *Empis brunnipennis* in Meigen Collection in Paris. A female, labelled "Meigen / 1091 40" and "*Empis brunnipennis* ♀",

although in a poor condition, is obviously the holotype ♀. The given characters of Meigen's diagnosis fit quite well to the preserved female as redescribed below. The second specimen is a ♂ with the same labels except for the sex sign; it has lost its legs but after dissection of the genitalia we have identified it as a ♂ of *Empis* (s. str.) *nuntia* Meigen, 1822.

Redescription of holotype ♀: Body length 3.6 mm, wing 4.5 mm long and 1.7 mm broad. Frons rather light grey dusted, broad, vertex and occiput above neck with tiny short black bristles, lower part of occiput with longer pale hairs. Antennae blackish on basal segments, segment 3 missing on both antennae. Labrum rather strong, shining blackish brown, about twice as long as head is high.

Thorax dull grey dusted on mesonotum, lighter on pleura, dorsum of thorax devoid of most of the bristles, only 2 fine dark anterior humeral and a strong black notopleural bristle preserved; acr and dc entirely rubbed off. Meigen (1822) described mesonotum as "graulich, mit zwei etwas undeutlichen dunklern Längslinien"; there are two narrow, darker and somewhat subshining stripes on the lines of lost dorsocentrals, and an indication of a median line on the acrostichals. Tip of scutellum damaged, scutellars thus lost. Metapleural fan composed of about 6 blackish bristles, similar 2 shorter bristles also at sides of pronotum and another one on prothoracic episternum and at sides of prosternum.

Wings rather broad and blunt-tipped, uniformly light brown infuscated with distinct dark veins, anal vein complete, distinct on its whole length. Costa and radial veins more blackish, stigma darker but indistinct, axillary angle scarcely less than 90°. Squamae pale with fine dark brown fringes, halteres whitish yellow.

Legs blackish, covered with grey dust, no pennation (hind tibiae and tarsi lost). Only fore legs are complete, covered with short adpressed black bristly hairs, venter of femora almost bare, similarly like on posterior four femora. Mid femora (Fig. 1) with fine adpressed hairs on dorsum, mid tibia with short black bristly hairs antero- and posterodorsally, as well as posteroventrally, and with a single longer black bristle anteriorly at about middle of tibia. Only right hind femur is preserved, it is clothed with only fine short adpressed hairs and it is distinctly laterally compressed; this answers Meigen's description: "die hintern Schenkel und Schienen zusammengedrückt, haarig. die Schienen nach hinten allmählig etwas breiter; das erste Fussglied so lang als die übrigen zusammen".

Abdomen less densely dusted grey than thorax, covered with light brown to dark brown hairs which are distinctly longer at sides of abdomen.

Empis brunnipennis Meigen is very similar to the female of *Empis gymnopoda* Bezzi, having especially the same type of thoracic dusting, the coloration of wings, and legs are similarly bristled. It differs from *E. gymnopoda* by the blackish metapleural bristles, the darker pubescence on the base of abdomen, and whole abdomen is more densely dusted on dorsum. The species is known to us only from the holotype ♀.

Empis (s. str.) *funesta* Meigen, 1838

Empis funesta Meigen, 1838: 84

Meigen described this species from both sexes from "Baiern" (= Bavaria, Western Germany). There are 1 ♂ and 1 ♀ in Meigen Collection in Paris label-

led "Meigen / 1098 40" and "*Empis funesta*" with a corresponding sex sign. Both the male and the female answer quite well even in details to the given short original description and there are no doubts that they are the types. The male represents a specimen of *Empis* (s. str.) *pusio* Egger, 1860, the female a specimen of *Empis* (s. str.) *chioptera* Meigen, 1804. Collin (1961: 540) wrote by mistake that the female of *Empis funesta* in Meigen Collection in Paris was a female of *Empis cincinnatula* Loew, but he did not mention the male. To avoid a change of name of the already well-known *Empis pusio* Egger we have selected and hereby designate the female specimen of Meigen's *Empis funesta* as Lectotype (it was labelled so in 1985). *Empis funesta* Meigen, 1838 becomes thus a new synonym of *Empis chioptera* Meigen, 1804.

APPENDIX

Notes on three Macquart's *Empis* s. str. species

Empis brevipennata Macquart, 1827

Macquart (1827: 126) described this species from the female sex only: "Les femelles sont assez communes; je ne connais pas le male". There are 2 ♀ of *E. brevipennata* Macq. in Meigen Collection in Paris, identified and sent by Macquart to Meigen. Both are females of *Empis* (s. str.) *caudatula* Loew, 1867, as it was already pointed out by Collin (1961: 540). Anyway, we quite agree with Collin's recommendation not to accept this synonymy "as sufficient evidence of the identity of Macquart's species to make any change in the use of the name *caudatula*".

Empis subpennata Macquart, 1827

Described by Macquart (1827: 127) from France as "Assez rare. Je ne connais pas le male" also from the femaly only. There is one female identified and sent by Macquart to Meigen under the name of *subpennata*, which is a female of *Empis caudatula* Loew as well. The only difference from *E. brevipennata* seems to be a smaller size. The specimen may belong to the syntypic series of *Empis subpennata* Macq. but, as to the synonymy with *E. caudatula* Loew, the same applies as given under *E. brevipennata*.

Empis maura Macquart, 1838

Described by Macquart (1838: 276) from both sexes from Algeria. There is a series of 7 specimens in Meigen Collection in Paris sent by Macquart under this name to Meigen. 4 ♂ and 2 ♀ labelled "126 38" are conspecific, they fit quite well to the original Macquart's description, and are all specimens of *Empis* (s. str.) *decora* Meigen, 1822. The seventh specimen of the series bears a different number "116a" and it is a male of an unknown *Empis s. str.* species with pale halteres, yellowish metapleural fan, biserial, very long and strong black acr and dc bristles that are spread right up to the front of mesonotum without intermixed pale hairs; furthermore, palpi are conspicuously densely strong black bristled, legs everywhere long black bristled, and abdomen is clothed with long whitish hairs. We have not yet seen such species in other collections.

Since the name *Empis maura* Macquart is an unavailable name, preoccupied by *Empis maura* Fabricius, 1776 (= *Hilara*), we have selected one male labelled "126 38" which is hereby designated as Lectotype of *Empis maura* Macquart,

1838 and it was so labelled in 1985. *Empis maura* Macquart, 1838 (nec Fabricius, 1776) becomes a new synonym of *Empis decora* Meigen, 1822.

There is a 'Supplementary note' of Collin (1961: 768) that "Col. Yerbury's specimens from Spain must be very much like Engel's *Empis andalusiaca*, and may be only a southern form of *decora*. Macquart probably described the same form (or subspecies) in 1839 (sic) as *Empis maura*, a name which was a primary homonym of E. *maura* F. (1777) (sic), and a species of which I have seen Macquart's type in the Paris Museum". It should be noted that one of us (O. S.) has revised the types of the Spanish *Empis andalusiaca* Engel, 1946, deposited in the Vienna Museum, and that they are conspecific with *Empis decora* Meigen, 1822. Thus both *Empis maura* Macquart (nec Fabricius) and *Empis andalusiaca* Engel should be quoted as synonyms of *Empis decora* Meigen.

Acknowledgements

We are very indebted to Dr. L. Matile and Dr. R. Contreras-Lichtenberg for the privilege to study the Meigen's types deposited in the Paris and Vienna Museums respectively. We are also grateful to Mr. V. S. van der Goot for the loan of types of *Empis albopilosa* de Meijere from the Amsterdam Museum.

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Dr. Milan Chvála, Department of Systematic Zoology, Charles University, Viničná 7, 128 44 Praha 2, Czechoslovakia.

Sokolov, V. E. (1984): *A dictionary of animal names in five languages. Mammals.* Publ. House Russky yazyk, Moscow, 352 pp. Price 3.30 R.

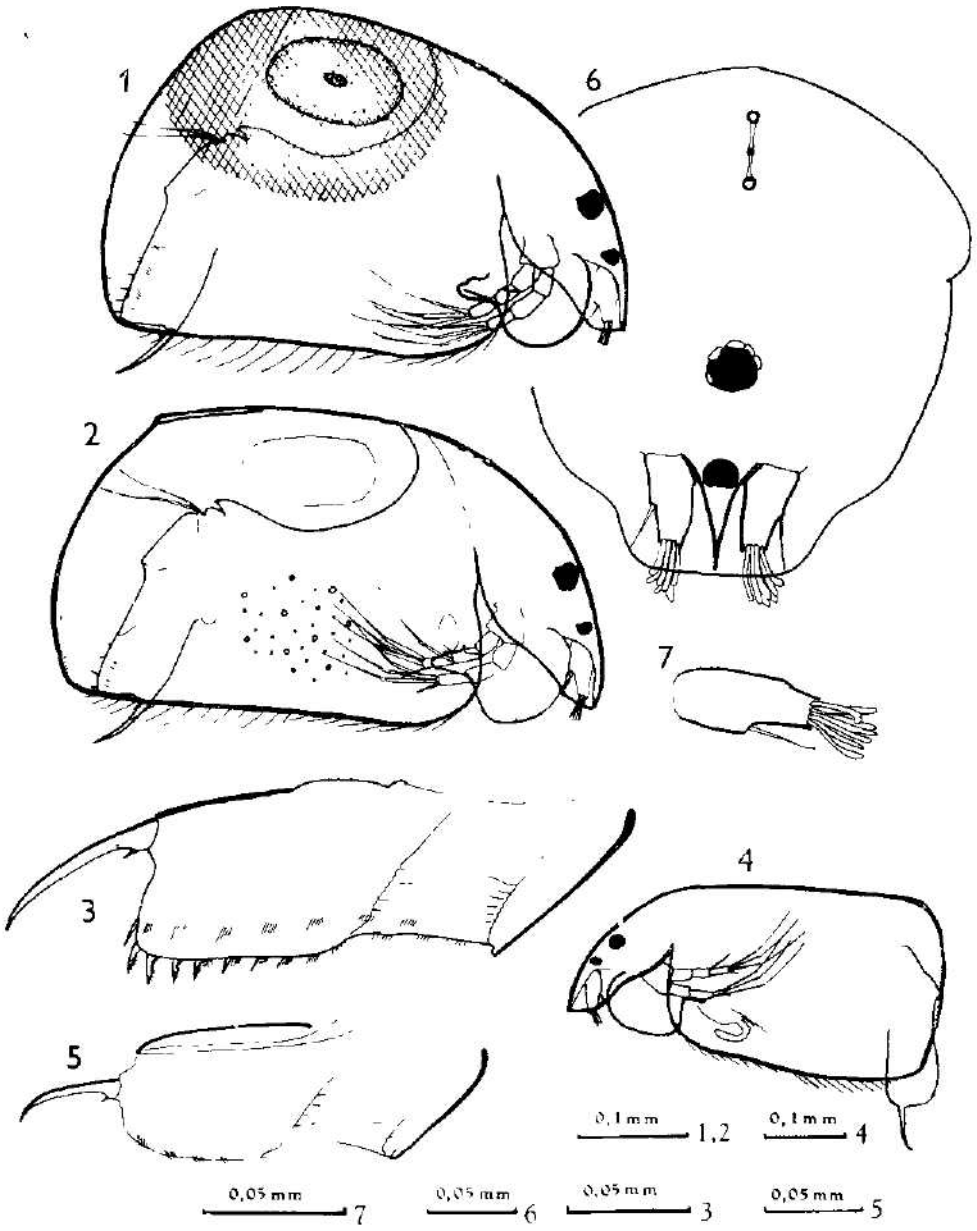
This is the first of the six volumes which will cover all systematic groups of the world fauna. It contains 5391 mammalian taxa including all living species of this class. The items are arranged alphabetically in systematical order and numbered. The names are given in Latin, Russian, English, German and French. The Latin synonymy is not included but it is so in other languages. At the end of the publication the lists of all taxa in five languages are given followed by a list of Latin species names. These lists form a very substantial part of the text covering nearly as many pages as the translantions of the mammalian names. As a whole, we have here an excellent book, first in the dictionary literature by its completeness. It may be extremely useful not only for translators but by its arrangement as a systematic survey also for scientific workers, pedagogues, students and all those dealing with mammals

V. Černý

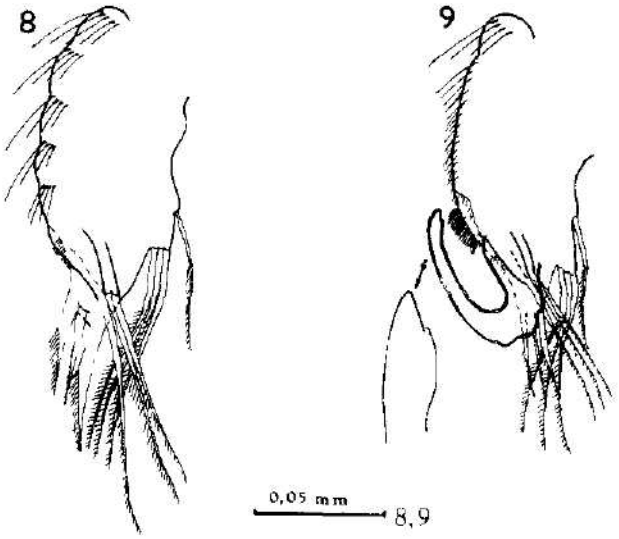
Sokolov, V. E., Kučeruk V. V. (Eds.) (1984): *Teriologija v SSSR.* (Theriology in the USSR). Publ. House Nauka, Moscow, 360 pp., 17 Tables. Price 4.90 R.

With respect to their immense economic importance, whether positive or negative, and with respect to their role in the circulation of disease agents the mammals have been since long ago in the centre of man's interests. This fact found its reflection in many-sided investigations devoted to this animal group. The same situation has been in Soviet Union where the needs for thorough studies of mammals were multiplied by the size and diversity of its territory where many areas were cultivated by man only in recent time. Numerous Soviet specialists and the results of their work are well known in the world science. The foundation of the All-Union Theriological Society in January 1973 and the organization of the First International Theriological Congress in Moscow in June of the following year testified about the intense development of this scientific discipline in the USSR. But until the present a publication was missing which would summarize the most important results achieved in different fields of investigations of mammals in the Soviet Union. The task of this book, in whose authorship 19 foremost specialists participated, was to fill up this gap. It is divided into 10 chapters. V. Yu. Reshetov and B. A. Trofimov bring a review of the research into fossil mammals in the USSR, V. B. Sukhanov and P. P. Gambaryan deal with general, functional and ecological morphology of mammals, N. V. Tupikova, V. V. Kucheruk and I. L. Kulik devote their chapter to theriogeography, N. P. Naumov and L. D. Andrianova discuss modern development trends in the ecological research of mammals, V. N. Bolshakov treats of the history and present state of the ecology of mammals in the USSR, L. V. Krushinsky, V. E. Sokolov, L. M. Baskin and M. N. Sotskaya report on the studies of the mammalian behaviour, A. V. Yablokov offers an outline of protection of mammals in the USSR, V. V. Kucheruk and Yu. A. Dubrovsky summarize the knowledge on medical theriology, V. V. Dezhkin and T. B. Sablina on game teriology and T. S. Gladkina and I. Ya. Polyakov on agricultural theriology. The broad spectrum of topics dealt with is stressed by the concluding list of references covering 84 pages. The book gives an excellent survey about the many-sided scientific activities of Soviet theriologists. It is a pity that also the results in the field of mammalian taxonomy were not included into the text. The publication to whose edition the authors are to be warmly congratulated is destined for a broad public of zoologists, pedagogues, workers in nature protection and game-keeping as well as for many other persons who in their profession come into contact with the given problematic.

V. Černý



Figs. 1—7. *Alona karelica:* 1 — ephippial female (Zatín—Bol), 2 — parthenogenetic female (Stražne), 3 — postabdomen of female (Zatín—Bol), 4 — male (Zatín—Bol), 5 — postabdomen of male (Zatín—Bol), 6 — head shield with head pores, dorsal aspect (Zatín—Bol), 7 — antenna of female (Zatín—Bol).



Figs. 8—9. *Alona karelica:* 8 — first trunk limb of female, 9 — first trunk limb of male (Zatín—Bol).

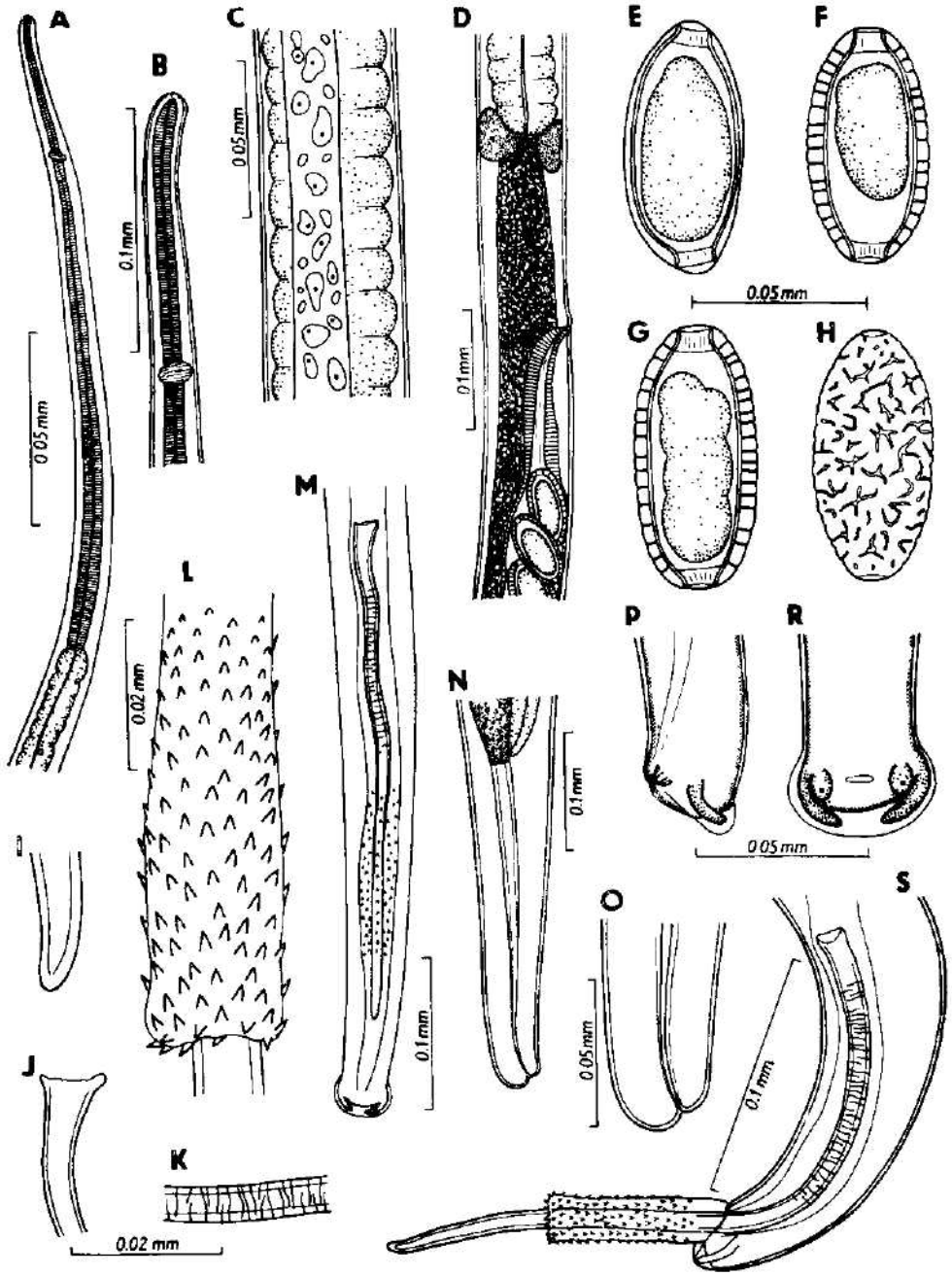


Fig. 1. *Amphibiocapillaria tritonispunctati* (Diesing, 1851) from European newts. A, B — head end; C — bacillary band in stichosome region; D — vulva region; E — immature egg; F—H mature egg; I—K — distal and proximal ends and middle part of spicule; L — spines on spicular sheath; M — posterior end of male, ventral view; N — posterior end of female; O — tail of female; P, R — tail of male, lateral and ventral views; S — posterior end of male, lateral view. (After Moravec and Lomakin, 1982)

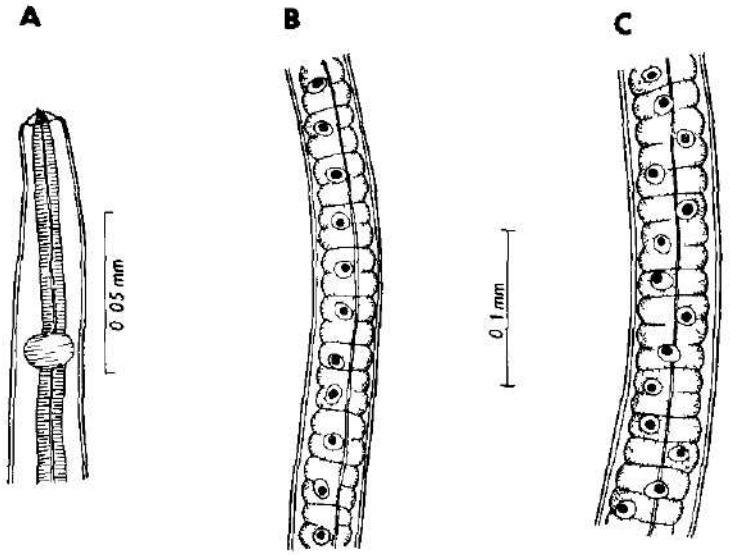


Fig 2 *Amphibiocapillaria tritonispunctati* (Diesing, 1851) from *Triturus cristatus* from England A — head end of female, B, C — middle and posterior parts of stichosome of gravid female

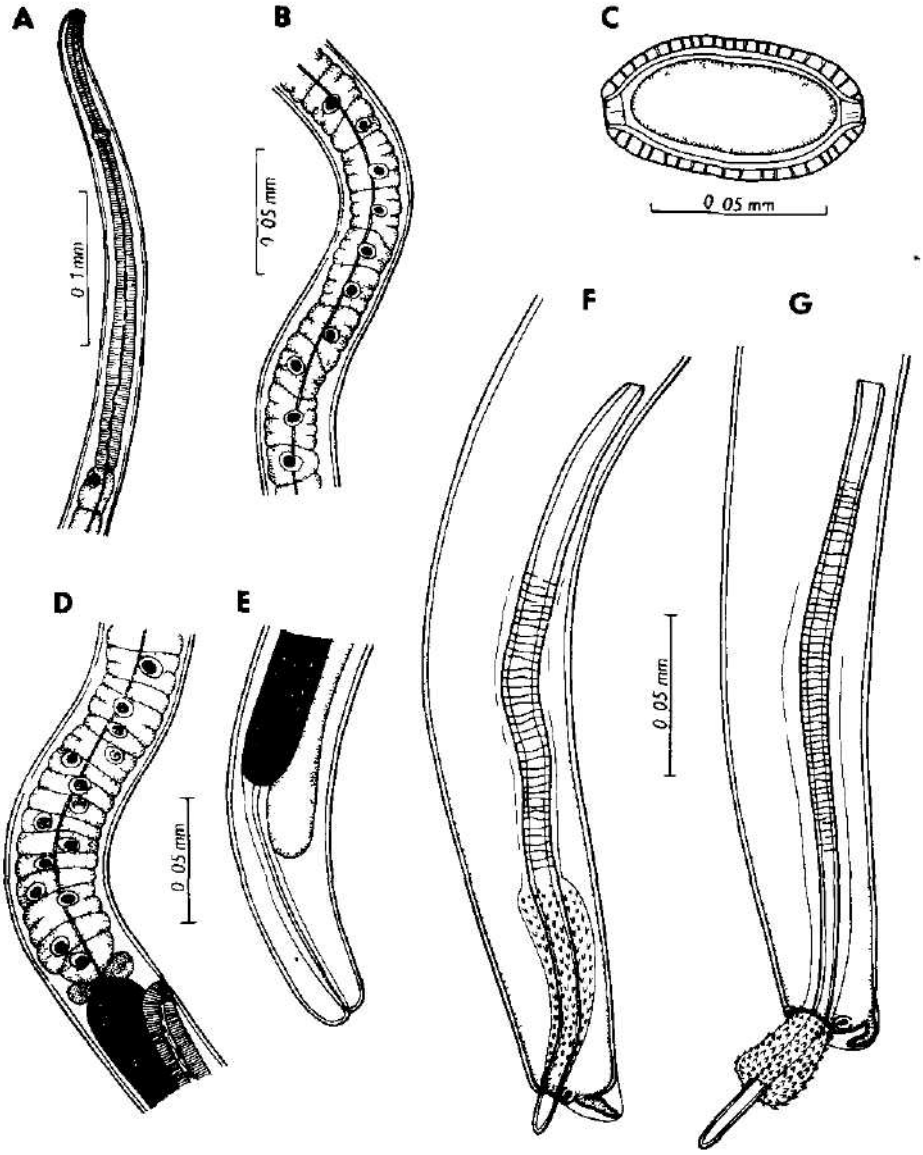


Fig 3 *Amphibiocapillaria tritonispunctati* (Diesing, 1851) from North American caudate amphibians A — head end of young female, B — stichosome region, C — mature egg, D — vulva region, E — posterior end of female, F, G — posterior end of male (A, B and D, E — "*C tenua*", C F — types of "*C inequalis*", G — type specimen of "C *brevicollis*") (A—B and D—G — from *Triturus viridescens*, C — from *Amblystoma opacum*)

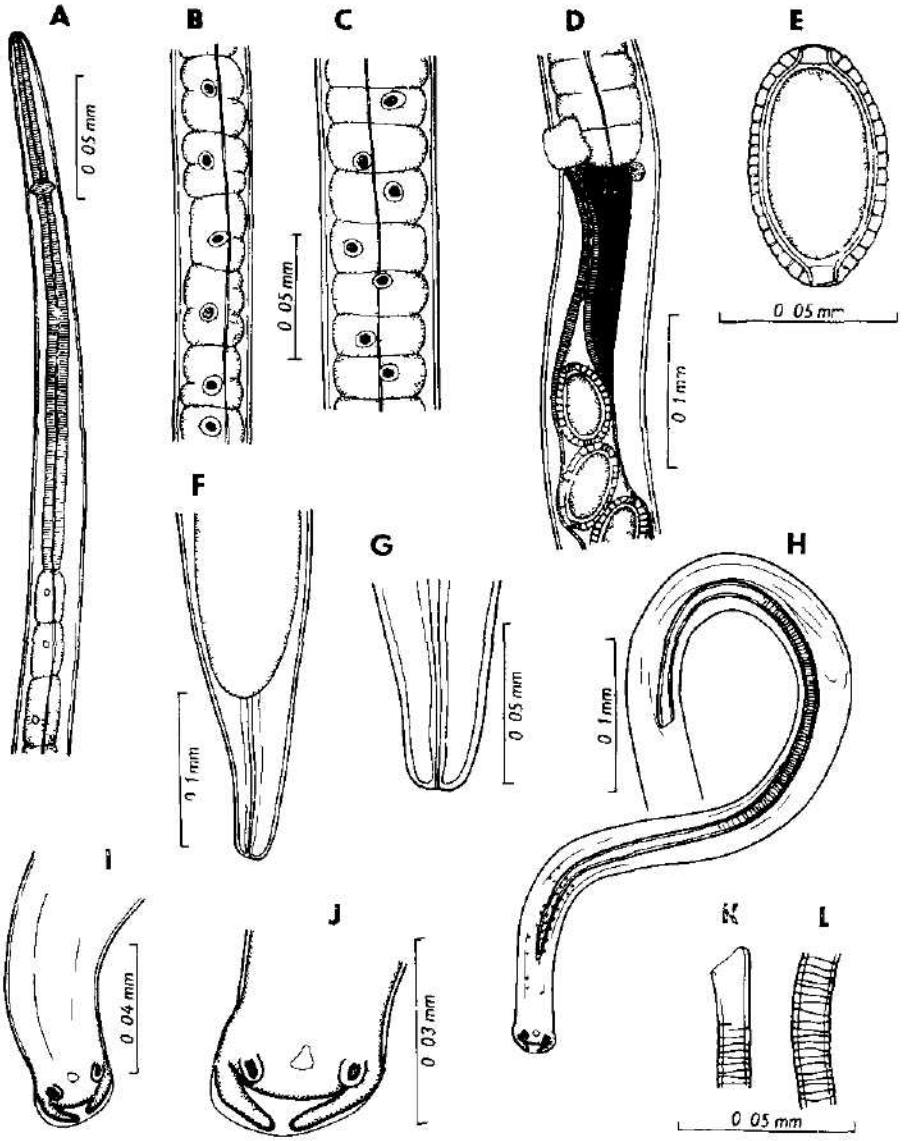


Fig 4 *Amphibiocapillaria costacruzi* (Travassos 1932) from *Rana esculenta* from Portugal A — head end, B C — middle and posterior parts of stichosome, D — vulva region (bent vulvar appendage partly overlapped by nematode body) E — mature egg F G — posterior end of female, H — posterior end of male I J — tail of male ventral view, K, L — proximal end and middle part of spicule

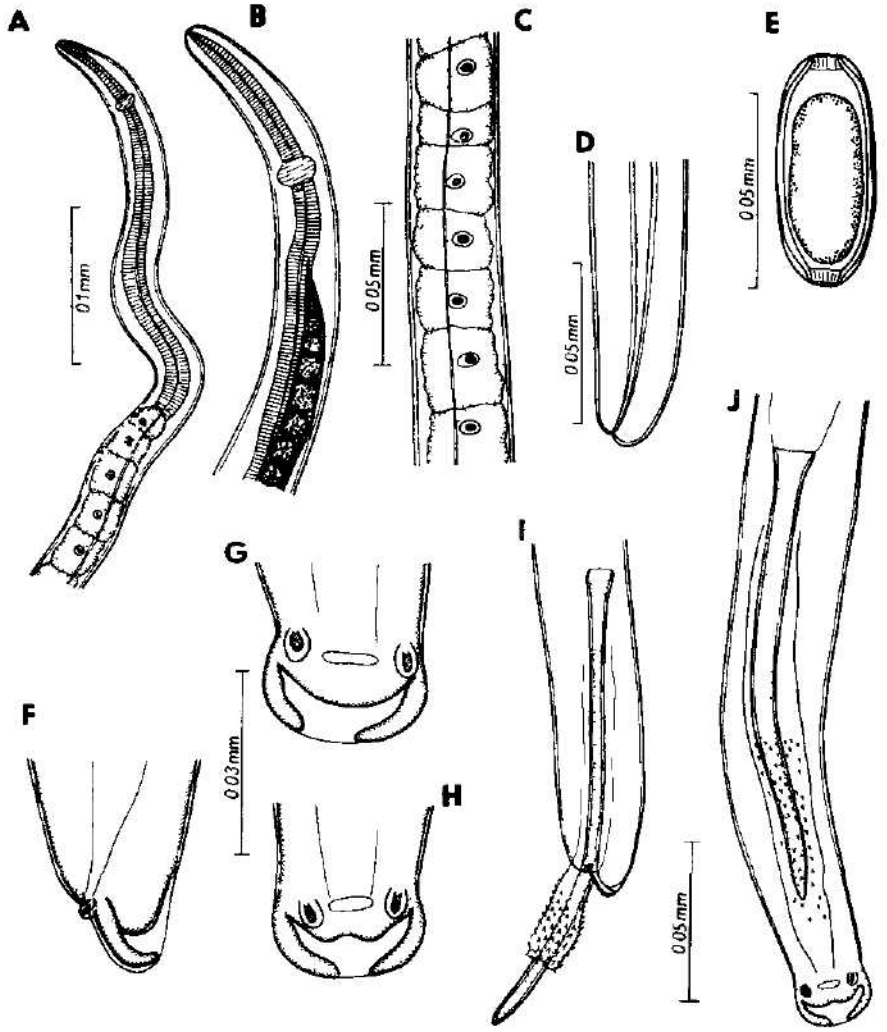


Fig 5 *Amphibiocapillaria tritoniscristati* (Diesing, 1861) from liver of *Triturus cristatus* from Czechoslovakia A, B — head end of young female, C — middle part of stichosome of young female, D — posterior end of female, E — mature egg, F—H — tail of male, lateral and ventral views, I, J — posterior end of male, lateral and ventral views (After Moravec and Lomakin, 1982)

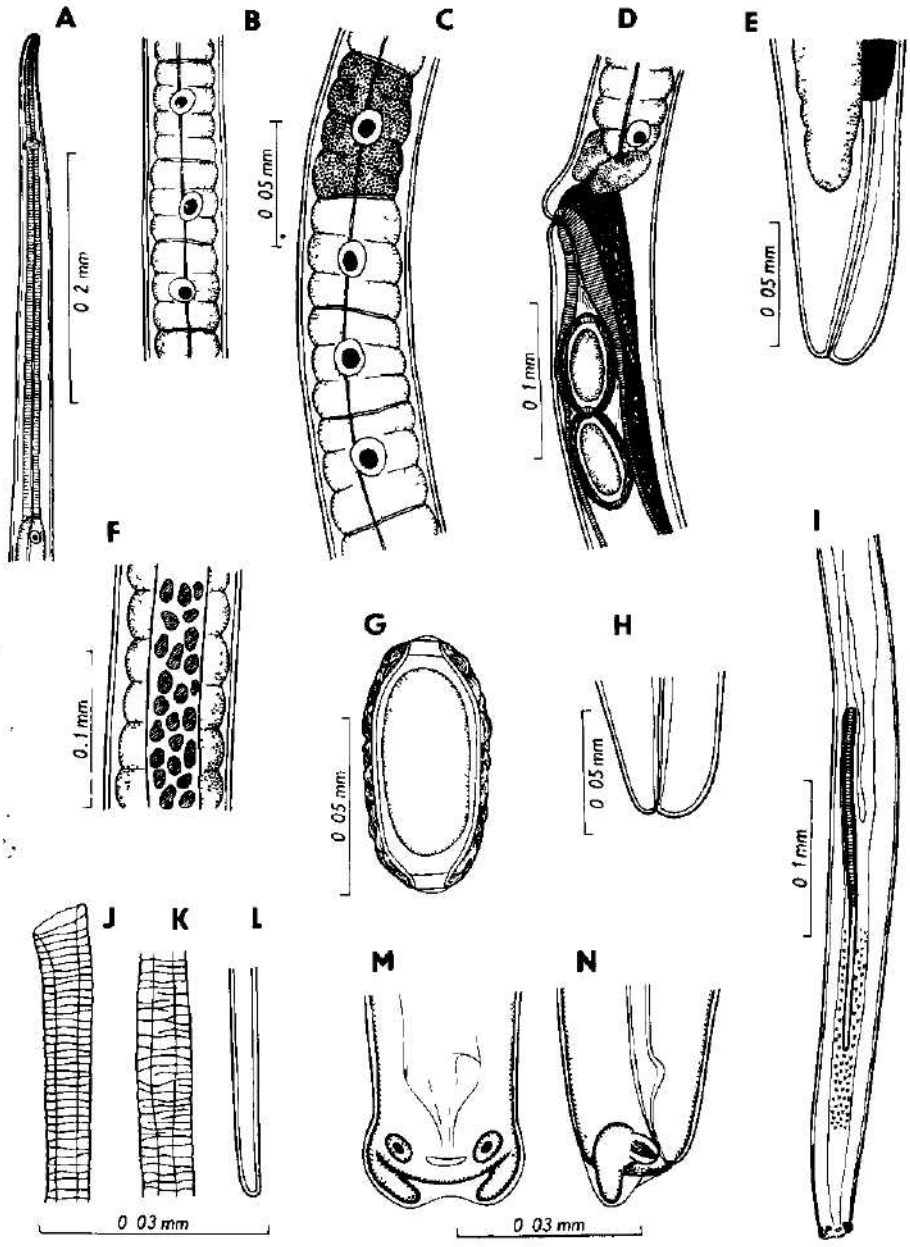


Fig. 6 *Amphibiocapillaria serpentina* (Harwood, 1932). A — head end; B, C — stichosome region; D — vulva region; E — posterior end of female; F — stichosome region with marked lateral bacillary band. G — mature egg, H — female tail; I — posterior end of male; J—L — proximal end, middle part and distal end of spicule; M, N — tail of male, ventral and lateral views. (A—H — from *Chrysemys decussata* from Cuba; I—N — from *Chelydra serpentina* from USA).

POKYNY PRO AUTORY

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Hlavička práce. 1. Název pracoviště. 2. Název práce (u prací taxonomických v závorce za názvem systematické zařazení druhu nebo skupiny — např. Ostracoda: Cyprinidae), obojí v řeči, v níž je práce psána. 3. Jméno a příjmení autora.

Vlastní práce: 1. Velmi stručný abstrakt, v rozsahu nejvýše 15 řádek, v angličtině. 2. Úvod do problematiky (stručně). 3. Materiál a metodika (u známých metod pouze odkaz). 4. Vlastní část experimentální nebo popisná. 5. Diskuse. 6. Závěr. 7. Seznam citované literatury (nikoliv bibliografie!). 8. Adresa autora. 9. Tabulky, texty k obrázkům a grafům. Celý rukopis je průběžně stránkován.

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Přepis cyrilice proveďte podle mezinárodních pravidel transliterace (nikoliv fonetické transkripce — viz ISO Recommendation R 9.. International system for the transliteration of cyrilic characters 1. Ed. October 1955 nebo Zekalle R., 1964: *Pedobiologica,* 4: 88—91, Jena.

Obrázky a grafy kreslete černou tuší na kladívkový nebo pausovací papír v poměru 1 : 1 až maximálně 1 : 2, u taxonomických prací musí mít obrázky měřítko. Obrázky kreslete pokud možno tak, aby mohly být všechny stejným způsobem zmenšeny. Fotografie musí být ostré, kontrastní, na lesklém papíře. Obrázky sestavte do tabulí, které by bylo možno reprodukovat na šíři strany (126 mm), nebo s textem na celé zrcadlo (126 × 188 mm). Obrázky nebo obrazové tabule průběžně číslujte a v rukopise vyznačte místo, kam mají být zalomeny.

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V taxonomických pracích dodržujte zásady, ustanovení a doporučení mezinárodních pravidel zoologické nomenklatury.

V rukopisu nepředpisujte zásadně žádné typy písma, označte pouze tužkou po straně části, které mají být vysazeny petitem.

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